THE RELATION BETWEEN PHYSIOLOGICAL, PSYCHOLOGICAL, AND SCHOOL AGES OF CHILDREN: A RESUME OF RECENT LITERATURE

BY

TENJES HENRY SCHUTTE
A. B. University of Illinois, 1912

THESIS

Submitted in Partial Fulfillment of the Requirements for the

Degree of

MASTER OF ARTS

IN EDUCATION

IN

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1916

UNIVERSITY OF ILLINOIS
THE GRADUATE SCHOOL

May 30 ___191 6

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPER-

VISION BY ___Tenjes Henry Schutte___

ENTITLED ___The Relation between Physiological, Psychological___

and School Ages of Children: A Resume of Recent Literature

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF___Master of Arts in Education___

___Guy M. Whipple___
In Charge of Thesis

___WC Bagley___
Head of Department

Recommendation concurred in :*

___
___
___

} Committee
on
Final Examination*

*Required for doctor's degree but not for master's.

The Table of Contents.

THE RELATION BETWEEN PHYSIOLOGICAL, PSYCHOLOGICAL, AND
SCHOOL AGES OF CHILDREN: A RESUME OF RECENT LITERATURE.

Chapter I.

Introduction: The Problem.

There is a growing conviction among educators that various ages of school children should be recognized; as, a chronological age, a physiological age, a mental or psychological age, and a school or pedagogical age. For instance, in answer to the question as to how old a certain pupil is, a person would most naturally think of the number of years that have elapsed since the pupil's birth, and reply, for example, that the pupil under consideration is twelve years old. The physiologist, speaking from his viewpoint, would not inquire as to the pupil's year or date of birth, but would consider the pupil's stage of physiological development and might reply that the pupil is, say eleven years old. By this reply he would simply mean that the pupil is developed physiologically as far as the average pupil is at the age of eleven years. But the psychologist, answering from his standpoint, might say that the pupil is thirteen years old, meaning thereby that the pupil is developed mentally as far as the average pupil is at the age of thirteen. Again, the educator, answering from his standpoint might say that the boy is twelve years of age, basing his reply on the progress the pupil has made in school.

The question naturally arises as to whether or not there is a definite relation or close correlation between these ages. This study simply aims to present a general survey of what has been done by others in this field. The solution of the problem should be attempted by an investigation of a large number of cases.

To show the attitude of others toward the importance and

feasibility of such an investigation a few direct quotations
might be given. Baldwin, in a recent work (2:6)[1] says: "There is
a growing conviction on the part of teachers and students of edu-
cation that there must be a close relation between the physical
and mental development of children and this relation must be re-
spected." Thus far we have no very definite knowledge, though
some investigations indicate that valuable information can be ob-
tained. A similar attitude is shown by Boas (8:18708): "The ques-
tion of physiological growth of children is of great importance in
education. Up to the present, studies have dealt largely with the
establishment of normal age-standards of growth. Much still re-
mains to be done in correlating growth, attainments, and educa-
tional progress. During life all the organs of the body undergo
important structural and functional changes, and therefore, pre-
sent different characteristics at different ages. The physiologic-
al development of the body does not proceed at an equal rate in
all individuals, who, therefore, do not all reach physiological
development at the same ages, some being accelerated in their de-
velopment, while others are retarded. The stage of the development
in the individual may be best observed in those cases in which a
noticeable anatomical or physiological change accompanies the at-
tainment of a certain physiological condition. The process of os-
sification, the eruption of the teeth, pubescence, the beginning
of sexual maturity, the eruption of the beard, and in later life

---

1. First number indicates reference in bibliography; second
number indicates page of reference.

the menopause in women, the turning of the color of the hair, the appearance of wrinkles, and the diseases of old age offer opportunities for observation. The measurements of children of the same age represent, therefore, individuals of different physiological developments; and their differences are the greater, the older the children. The conclusion must be drawn that during this time the individual differences in measurements, structural and functional traits, must be the greater the more rapid the rate of development and growth." On the basis of the work by Porter and Crampton, Boas also concludes that "retardation of physical development is closely associated with retardation of progress in school;" and that "rapid physical and mental development go hand in hand."

If the position taken by Foster (22:83) is substantiated it is of obvious significance to education. He maintains that boys naturally want to associate with other boys of similar maturity, regardless of age, and if left alone, instinctively group themselves pretty much according to physiological age. He thinks that "smaller boys are usually not unwilling to associate with larger boys but are usually not found with them out of school." Again he states that chronological age is not a good index of development, since various causes may enter to retard development; and often boys are found fourteen years of age who are physiologically older than others sixteen years old. Hence, he concludes that since a classification on a physiological basis is easy and practicable, and since the groups classified on a physiological basis manifest greater efficiency (because of more pleasant association), such grouping should be resorted to in the public schools (22:88).

King urges that the physiological development of the child ought to be known for the sake of his school work. He maintains that progress in school grades is related to progress physiologically (32:36). In another place (33:227) he asserts that the "younger groups of each physiological age do better work than the older groups."

Mead also believes that there exists close correlation between mental and physical development. He remarks (38:394) that there "seems to be some correlation between mental dullness or brightness and general bodily growth of children." From data which he gathered (38:405) he concludes that "not only is mental defect reflected, on the average, but the more decided the defect, the more checked the physical growth."

Rotch, like Porter and others, believes in classification on bases other than chronological age. In a recent article (41:;85) he says: "The number of years a child has been born is a most unsound rule for placing him with others of the same age, either in his studies or in his physical exercises. There is an age in years, a physiological age, an atomic age, and a fundamental cerebral age. Physical and mental capacity, so far as chronological age is concerned, differ often by one or two years."

Before speaking of Crampton, who is probably the person most actively at work on this subject, the views of other writers, pro and con, might be briefly stated. Smedley:(42:113) "In general, there is a distinct relationship, in children, between physical condition and intellectual capacity, the latter varying directly as the former." Porter:(40:180) "No child whose weight is below the average of its age should be permitted to enter a school grade

beyond the average of its age, except after such a physical exam-
ination as shall make it probable that the child's strength shall
be equal to the strain." Zirkle:(53:3) "It has been conclusively
shown that the mental and physical are mutually interdependent."
West:(50:158) however, concludes that, "Precocity bears an in-
verse ratio to bodily development." Gilbert maintains that there
is no correlation between physical development and mental ability:
"My data show no correlation between weight, height, and mental
ability, but give a negative result, and if any positive result
can be stated at all, it would be that the taller and heavier the
children, the duller they are" (25:39).

Crampton, as was shown above, is probably one of the most
keenly interested persons, working on the physiological age of pu-
pils. He says: (13:230) "The physiological age should be taken as
a basis for all record, investigation, and pedagogical, social, or
other treatment of children." According to his view, human indi-
viduals like those of any given species, may vary in rate of de-
velopment, and the extent of this variation may be very marked in
some cases. In a recent article Crampton defines the different
ages: (14:70) "Physiological age refers to the stage of develop-
ment which the child has reached, in contradistinction to the
chronological age, which merely states the number of years which
it has lived." According to him the anatomical and the physiolog-
ical ages may be regarded as the same. "Psychological age, however,
refers to the status of the development of the mind and we have
ample justification in assigning this term to psychological devel-
opmental groups, based upon the appearance of a new mental function,
such as the appearance of a desire to play team-games instead of

individual games, or to remember things by association rather than by rote." He agrees with others that years of life do not indicate the stage of development. In speaking of education he says: (14:71) "Its maladjustments are particularly evident and distressing at or about the time of puberty." In still another article (15:462) he speaks even more emphatically: "The doctrine of physiological age affirms the fact that mental and physical development of children, adolescence, and adults proceeds through easily recognizable and discreet [discrete] stages, and it main- tains that all classifications and grouping of the growing and developing human being should take cognizance of, and relate them- selves primarily to, these stages and secondarily, and in a decided- ly minor way, to the artificial grouping upon the basis of school grade or chronological age........Developmental signs may be ana- tomical, such as the appearance of the six-year molars, the wis- dom tooth or pubic hair; or physiological, such as menstruation, change of voice, menopause; or psychological, such as the change in rote to associative memory, the wane of the collecting tendency, the budding of the earning instinct, and the characteristic rumin- ation of senescence. We have sought to ascertain by extended and intensive investigation what the significant stages of change may be and to hit upon early recognizable signs whereby we may, from observation, denominate a child or adult to be in this or that stage, so that we might place him in classes of individuals of similar stages of development for the purpose of adjusting and standardizing our medical, scholastic, and social treatment to natural instead of artificial requirements."

It needs little reflection to see that we are confronted with

conflicting views, though there is a general tendency to favor
the idea that there is a close relation between the ages mentioned.
It has also been shown that the interrelations of these ages may
affect progress decidedly. Hence, it seems to be worth while to
go into the problem more carefully.

The questions which at once arise are: (a) How is pedagogical
age determined? (b) How is psychological age determined? (c) How
is physiological age determined? (d) What facts are now available?
and (e) How are these facts related to one another? Consequently,
we shall proceed to consider in order:(a) the methods of determin-
ing the pedagogical or school age; (b) the methods of determining
mental or psychological age; (c) the methods of determining phys-
iological age; (d) the chief results for school, mental, and phys-
iological ages;(e) some interrelations on the basis of these vari-
ous ages and conditions as conditioning success in school.

Chapter II.

Methods of Determining School Age.

In determining the school age, or the pedagogical age, of a
child various plans, schemes, or methods are proposed. The ideal
scheme, as it is supposed to be applied to the individual pupil,
assumes that the pupil has at least a certain degree of mental de-
velopment when he enters school. Every year, or half-year, or at
some other periodic interval, the pupil is supposed to be promoted
to the next higher standard or grade, if he has made normal prog-
ress.

In dealing with a mass of pupils this ideal scheme is found
to be impracticable for many reasons. Children at the age of five
or six enter school at widely differing stages of mental develop-
ment. But suppose that an ideal group could be found, one in
which all the children had exactly or very nearly the same stage
of mental development, we would then have to suppose also that
they had exactly the same degree of ability to make progress in
all the subjects, and, in addition, the same degree of energy, will,
desire, and opportunity to make progress. If such accompanying con-
ditions, or conditions at least approximating these did not exist
at the close of the first period, when time for promotion had ar-
rived, we should then find children with differing stages of mental
development. A similar condition would arise throughout the entire
school course. So we see immediately that the ideal scheme of pro-
motion can not be applied to the mass of pupils, and hence, not to
the individual pupil.

What, then, are some of the conditions which determine promo-

tion, or what implications can be drawn when we say that a certain pupil is in the sixth or eighth grade or in the second or fourth year of the high school? It is clear from what has been said before that we can not guarantee that the pupil has reached a certain mental or psychological stage of development nor that he has acquired a certain amount of knowledge, for we do find different stages of development in every grade. Wallin (49:445-466) points out that promotions are frequently made for quite different reasons, for instance, because school authorities expect to see a certain per cent. of the pupils promoted at the given time; that is, a creditable showing must be made. Again, parents desire that their children make progress in school, and promotion to a higher grade is felt to be an indication of progress, whether such promotion be merited or not. Again, parents often want their children to hasten through school in order that they may be placed in some productive station in the economic field. Also a certain sentimental pride is connected with promotion, and hence, pupils not promoted tend to become discouraged and drop out of school. Also the teacher believes it better to promote the pupil and keep him in school an additional year or two. Moreover, there are certain devotees to the liberal policy of promotion who recognize the school is an arbitrarily arranged institution and feel that the child has a right to be promoted regardless of merit. In still other cases, crowded conditions make promotions necessary to make room for the newcomers and frequently there has been developed a custom to graduate all those who have reached the last grade in the grammar or high school.

Recently some attempts have been made to define school age.

Smedley, in his Report on Child Study, No.2, suggests the normal grade for a pupil may be stated approximately by subtracting six from his age, i.e., he assumes that six years is the normal age for pupils to enter school. Blan (7:2) indorses this method of determining school age; as also does Keyes. Others, notably Greenwood of Kansas City (7:2), say that "retardation is not a question of age without respect to progress, but it is one of time required to do a given amount of work within a specified time without regard to age." These would make allowance for the pupil who has lost a grade because of sickness, moving, or causes other than lack of ability or will to work. That is, they recognize what might be termed pseudo- or accidental retardation.

Strayer is more liberal than Smedley in making age allowance. He says (45:-) "Strictly speaking, a pupil is to be considered retarded only when he has repeated one or more grades." He defines the normal age of pupils: (44:12) "children six or seven years of age in the first grade; seven or eight years of age in the second grade; eight or nine years of age in the third grade; and so on, are called normal."

Almost universally in secondary schools and in some cases in elementary schools, pupils are promoted by subjects. Under this scheme a pupil is required to have made passing marks in a certain number of subjects in order to be graduated or promoted to the next higher year or grade. In other elementary schools they are merely required for promotion to make passing grades in what are regarded as the essential subjects. Now, in view of what has just been said and further evidence to be presented, we see very readily that school age corresponds to mental development only in a very gen-

eral way; that is, it is merely an ideal which we desire to reach.
Also it is obvious that the statement that a pupil is in any par-
ticular grade simply means that he has gone over a certain amount
of subject-matter, and presumably made at least a fair record in
that work. This position is held likewise by Chambers (12a:61), who
says that the principles on which the grading of our schools is
carried out seem to be unrelated to the physical and mental traits
of the pupils.

The ideal of a promotion system as stated by Snedden (43:-)
is that "at any stage the object of a system of grading is to pro-
duce groups or classes that are fairly homogeneous as regards at-
tainments at the moment, and also capacity to make a certain rate
of progress throughout a course of study as organized............
The rate commonly employed in practice is that which has been de-
termined by experience as one suitable to a majority of normal
children."

The practical outcome of such a system is well expressed by
Chambers (12a:61): "A rigid system of grading and promotion must
work injustice to individuals because pupils of a given grade are
not equally endowed in any one subject, and no one of them has the
same rank of ability in all the different studies of the grade...
...Since under present conditions, grading is necessary, it should
be made to depend on natural, rather than artificial distinction."

Again he says (12a:71) "To assume that in two school grades we
have two distinct species, that certain abilities are lacking in
the one and present in the other, that all the members of one
class are approximately equal in ability in a certain field and

that they are all inferior in that ability to all the members of
the other, is, at best, a very hazardous guess...... Teachers can
not afford to forget that our school grades do not represent dis-
tinct gradation of ability in pupils, but are simply convenient
devices of administration to facilitate the handling of children
in the mass. The grades are determined by reference to more or
less artificial standards and too often do not represent the real
intelligence, industry, endurance, adaptability, and other traits
important for education, of the pupils. It seems as if ability in
perception, association and memory, when these functions are test-
ed on familiar material should be pretty closely related to edu-
cability, and should be affected by the school progress to an ex-
tent distinguishable in successive grades, if the grades really
grade. He points out clearly (12a:72) the absurdity of regarding
our present grading system as even approximating an ideal system:
"in one sense, the very principle of rigid grading is a psycholog-
ical absurdity. The demand that all members of a class shall pro-
ceed at the same pace presupposes an equality of abilities which
does not exist; the requirement that all shall meet the same
standards of thoroughness and finish rests on the same fallacy;
the practice of having those that are grouped together in one sub-
ject recite together in all subjects rests on the assumption that
a pupil maintains a given standing in all subjects - an assumption
which is by no means justified by the facts. Even in the light of
conventional standards no mind is symmetrical, and it is a rare
exception to find a student who occupies a corresponding rank in
all his studies."

Holmes discusses a few plans of classification (30a:26-61)

only the main features of which will be mentioned here, since the primary object of this thesis is not to deal with promotion plans. First, the St. Louis Plan: promotes the better pupils at short intervals by making frequent reclassificatidn. Second, The Elizabeth Plan: each grade is divided into divisions depending upon the abilities of the pupil. Each group advances as fast as possible; that is, the pupils are advanced as soon as they give evidence of proper ability. Progress is gauged by the work in the sequential studies, reading and number in the lower grades, language and arithmetic in the higher. Third, The Santa Barbara Concentric Plan: each grade is divided into sections A,B,C. The sections do the work concentrically, that is, all work on the same fundamental principles; but the pupils of Section B do more work than the pupils of Section C, and the pupils of Section A more than those of Section B. Fourth, The Cambridge Plan: this is applied only in the last six years of the nine year course. A sliding scale is arranged by which pupils can do the entire work in seven, eight, or nine years. This makes it possible for all pupils to make progress and to make varying grades of progress. Such an arrangement is possible only in large systems. Fifth, The LaMars, Iowa, Plan: this is the Cambridge Plan applied to the nine years instead of to the last six. Sixth, The Portland, Oregon, Plan: the course of study is divided into fifty-four parts, covering in time, eighteen terms of five months each. Seventh, The North Denver Plan: the pupil has to fulfill minimum requirements; special work is arranged for the more apt pupils; the better pupils may be excused from recitation part time. By this plan no pupil can hurry over the course but he is given an opportunity to gain additional

strength.

The various plans of promotion show that methods indicated by Smedley and Blan for determining school age would be inaccurate in many places, particularly where special provision is made for slow or rapid progress as determined by the child's ability.

Chapter III.

Method of Determining Mental or Psychological Age.

Though there are many schemes and types of mental tests, this chapter proposes merely to give a brief outline[1] of the method of testing intelligence on a basis of age gradation as inaugurated by Binet-Simon in 1908, and revised in 1911. The authority for this chapter is found primarily in (52:-). Whipple

The requirements to be satisfied by this method are that a satisfactory test was to be found for each year of childhood; these tests must not be influenced by external or chance conditions and especially not by school learning; it should be possible to use these tests in different nations, languages, and stages of culture; the test should be easy to apply and not require laboratory apparatus; little time should be required and the subject should not be fatigued by the application of the tests; and lastly, from the application of the tests the examiner should be able to evaluate the general intelligence of the subject.

As the tests appear in their revised form there is a series of five tests for each year of childhood from three to thirteen. Some of the aspects of intelligence tested in this serial are memory in its various forms, extent and availibility of vocabulary, suggestibility, motor ability, practical accomplishments, and in-

---

1. A general familiarity with the Binet-Simon tests, on the part of educators may be assumed. For further references on these tests see Koho, S.C. "The Binet-Simon Scale for Intelligence; an Annotated Bibliography," Journal of Educational Psychology,V(1914) 215-24,279-90,335-46. Also published as a reprint.

tellectual activities; like comparison and sensory discrimination, logical discrimination, aesthetic comparison, power of defining terms, completing omissions of texts, combining words, orderly arrangement of sense material and of logical verbal material,etc.

Many of the tests appear in different phases at various age-levels so as to demand a varied standard of performance. An especially great merit of some of the tests is that the solution does not depend on the readiness in the use of speech; as, for instance, the arrangement of five weights, aesthetic comparison, and recognizing omissions in pictures; other phases are thought too dependent on external conditions, especially on home conditions; some, like knowing a coin, depend too much on mechanical memory.

Stern recommends that the examiner should always do his work with an assistant who does the recording so as to avoid dividing attention between testing and making records. Both experimentors should have a high degree of practice and be well used to each other before attempting the tests for investigatory purposes. In applying the tests the examiner must never permit it to be seen that some answers are more or less satisfactory to him that others- he must maintain an attitude of "uniform and quiet friendliness."

The examiner should begin at an age-level not too easy nor too difficult for the subject; he must avoid monotony and introduce short pauses if fatigue becomes noticeable. It requires from twenty to thirty minutes to test a normal individual, and from thirty to forty-five minutes to test an individual of subnormal intelligence.

The grade of intelligence of the subject is determined by assigning him to the highest age-level in which he passes all the

tests, save possibly one to allow for a momentary flag of attention; to this is added one year for each five tests he passes in any of the age-levels beyond the one to which he was assigned. For instance, if the subject were to pass all the tests at the age-level of seven years, and then two in the age-level for eight years, two in the age-level for nine years, and one test for ten years, he would be assigned to the group eight years old.

Chapter IV.

Method of Determining Physiological Age.

The present chapter describes four criteria which have been proposed for determining physiological age: (A) Development of the wrist bones; (B) Eruption of the teeth; (C) General bodily development; and (D) Pubertal phenomena.

A. Relation between physiological age and development of the wrist bones: X-Ray Method.

Rotch says (41:396): "As is now universally known, the number of years that a child has been born is a most unsound rule for placing him with others of the same age either in his studies or in his physical exercises." His plan is to discover the normal correspondence of all these ages (chronological, physiological, anatomical, and functional-cerebral) and to use that correspondence in grading pupils. He regards the methods of grouping by chronologic age, height, weight, or muscular strength as unpractical, elusive, and irrational.

Rotch advocates using the skeleton as the basis for grading pupils, since it represents the framework of the entire body. "The epiphyseal index of development, although only one of the factors in the developmental problem is more important and far-reaching than any other of the factors" (41:397). Height, weight, and chronological age should not be disregarded, but any one taken by itself is misleading. "In an extensive study of the carpal bones and the epiphyses to the time of union, I have found that they present a complete index of the entire osseous development of the individual and advance in regular progression step by step" (41:397). The a-

pearance of the carpal bones and the epiphyses of the radius and ulna represent the stage of development of all the other epiphyses throughout the skeleton, so that the bones of the wrist can be relied upon to judge of the epiphyseal development without having to take **Roentgen pictures** of the other epiphyses.".....**"The appearance of the carpal bones and of the epiphyses of the radius and ulna serves as an index for the** period of infancy and childhood up to **the time when the child is** about to enter the higher grades of **study."** For the later stage, up to the adult stage of the completion of ossification and union of the epiphyses of the radius and ulna, metacarpal bones, and in succession those of the phalanges, which show the progressive development of the adolescent to the adult and anatomical age," should be used as a basis. Thus the hand and wrist are the only members which need to be examined.

He found (41:398) that the epiphyses which appear first are the last to unite. His experiment demonstrates, he thinks, that " where there is a delayed mental development, even though the height and weight correspond to the chronologic age, the development of the epiphyses and carpal bones corresponds more to that of the brain than to the general physical condition."

The value of this X-Ray method is flatly denied by Crampton (14:75). The basis of this denial had better be stated in his own words: "There is unfortunately not a shred of evidence that the development of the bones of the wrist have related to them in any way any physical or mental ability of any kind, and not until this evidence has been presented can we in any way give attention or credence to the claims of this method." He further criticizes Rotch's method of designating the different gradations of develop-

ment. "Rotch's developmental processes which cover about the stage
of the appearance of puberty and labeled H,I,J,and K differ from
each other only in the fact that they are the same as the previous
stage 'only more so'; that is to say, stage J differs from stage
K only in the fact that the bones are slightly more developed and
more massed together." Crampton regards this view wholly a "matter
of opinion that is not objective enough for scientific or practical
purposes." He thinks that there is no particular reason why the
bones of the wrist should be preferred to those of the ankle or
any other convenient part of the body, and further maintains that
the ossification, as has been discovered, does not proceed regular-
ly throughout the body. He says that there is even a difference
between the right and left wrist.
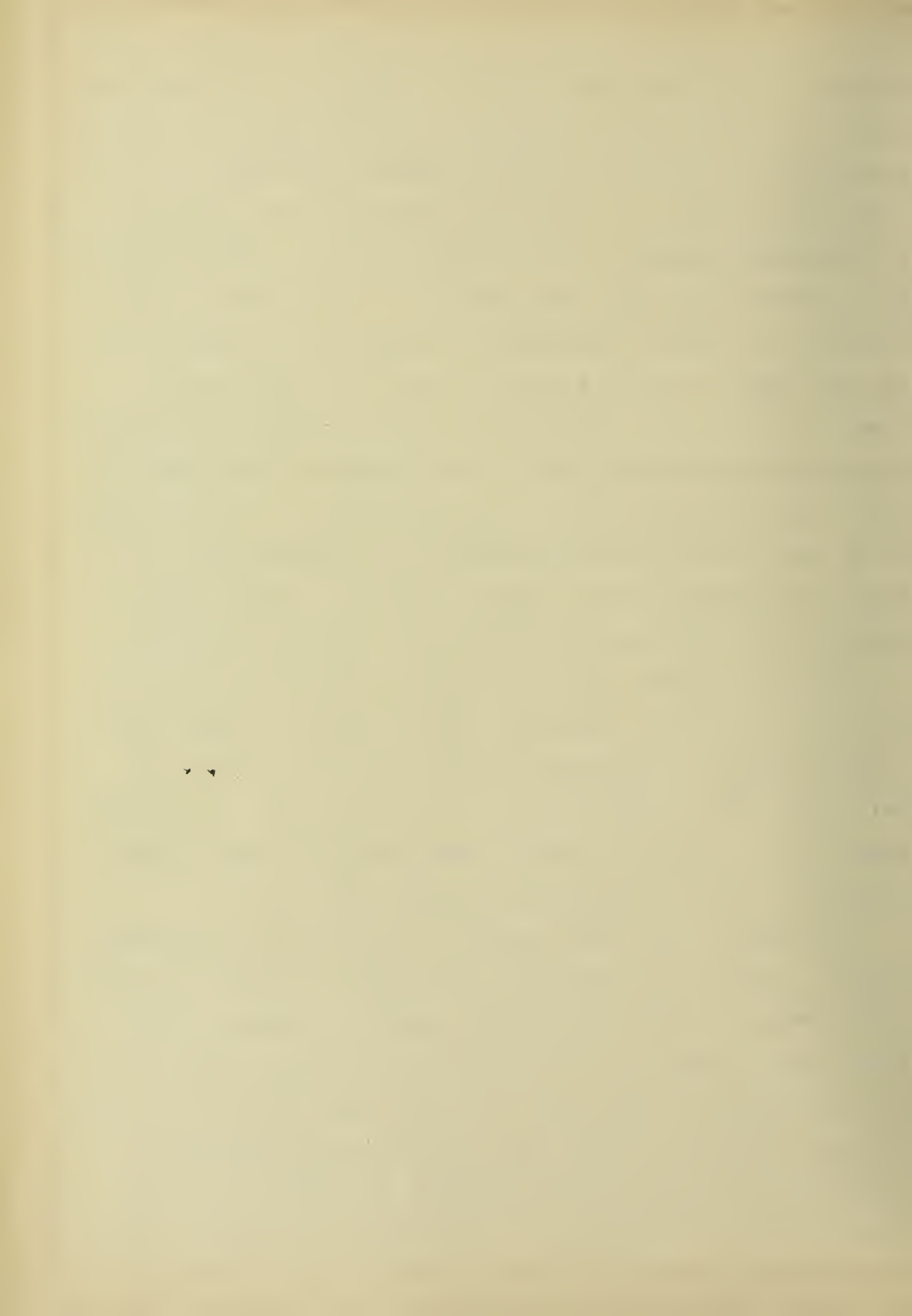
B. Relation of physiological age and tooth eruption.

Beik says (4:297) "Data with regard to time of the e-
ruption of the teeth seem to indicate a close relation of denti-
tion to the general stage of advancement." Crampton found a def-
inite relation between tooth appearance and height, and between tooth ap-
pearance and weight (17:345-358). Hence,if this relation be admit-
ted and a relation between height and weight and physiological de-
velopment and a further relation between physiological development
and mentality,then we may also hope to find a close relation be-
tween eruption of the teeth and mentality. Boas and Wissler have
arranged a table to show the approximate age of appearance, in
both boys and girls, of the inner incisors, the outer incisors, the
bicuspids, the canines, and the second molars (4:289). From this
table it seems that there is a close relation between eruption of

the teeth and other physical development.

Bean (3:606) says: "The time of eruption of the teeth, or of any tooth varies with sex, with race, and with morphologic form as well as with age." "No single factor, such as stature, or weight, or the epiphyses of the bones, or the eruption of the teeth, or the presence or absence of secondary sexual characters, or any other factors will be sufficient alone to establish the relative development of the individual, although one factor may be worth more than another in this respect," (3:610). He tries to show the value of eruption of permanent teeth for determining the standard of development, and maintains that the periods of accelerated and retarded bodily growth are definitely related to tooth eruption, which he determines (3:597) by taking the average or mean number of teeth erupted or erupting at each age, as well as the median, the mode and the extreme. "The correlation of the eruption of the teeth and growth in stature of the sexes is close" (3:600).

C. Relation between physiological age and general bodily
size: weight and height.

Baldwin (2:66) says; "There is a direct correlation between physiological age as evidenced by height and weight and the advent of menstrual functions. Height and weight offer excellent objective criteria for teachers and parents for determining the advent of menstruation, as a factor in pubescent development and the onset of maturity." He shows that the appearance of that function depends not only on chronological age, but also in particular on the height of the girl. He says (2:69) "The per cent. of increase in height increments over the initial heights for a given chrono-

logical age from six to eighteen is so comparatively uniform in many cases that the growth curves may enable us to prophesy with considerable accuracy how tall a child of normal growth should be at any subsequent age within the interim, provided his relation to a given median or norm be known." He draws his conclusions by comparing the boys and girls above and below the median height and weight to the stage of physiological maturity reached as evidenced by primary and sex functions. Again he says (2:90); "The general conclusion of this section of our study is that if pedagogical age be accepted as a fair equivalent (in these three efficient schools) to mental development, the tall boys and girls with good lung capacity are older physiologically and further along in their stages toward mental maturity as evidenced by school progress than the short, light boys and girls."

Burk, Crampton, and others made very intensive studies in regard to height and weight of pupils. They determined the periods of acceleration and retardation for both sexes and found that these vary as compared to the chronological ages. Then these results were compared to the school standing of the pupils. They, too, found that there exists a close relation between physiological development, height, weight, and school standing. Porter, in particular, concluded that scholarship is primarily dependent on the development in the height and weight of pupils.

D. Relation of physiological age and pubertal phenomena.

Crampton argues quite emphatically that physiological age should be determined by reference to pubertal phenomena. On this basis he proposes to be able to determine the basis of physiological maturity a child has reached; and since his mental maturity

is dependent on his physical maturity, it follows that a grouping
for school purposes can be made on a basis of pubertal phenomena.
He repeats the assertion made by many others that the ".sexual
ripening produces an entirely new mental outlook upon life; the
earning instinct looms large in the boy and the home-making in-
stinct in the girl" (14:72).

Again he points out that we disregard the important fact that
the pubertal change leaves the child a wholly different being,men-
tally, physically,morally, and ethically in comparison with chil-
dren in the stage just left behind. This disregard results in
teaching in one group classes of children, some of whom are in
prepubertal and others in postpubertal stages; the immature and
the mature have the same form of discipline,- a condition of af-
fairs which is detrimental to good school work. This condition is
found particularly troublesome at the point of articulation be-
tween the elementary and the high schools. The trouble arises from
the fact that much of the teaching in the elementary school is,
and must be,on a basis of authority and that the pubescent tends
to rebel against authority. He is held down to lessons in which he
has no interest and the result is failure.   "The pubescent is
wholly different in every way from the post-pubescent; he is still
a child, while the post-pubescent is a man; it is, therefore, rea-
sonable to maintain that we should treat them differently,"(15:462).
Pubescence is an evidence of sexual ripening and of the beginning
of adolescence" (16: 115). Crampton recognizes three physiological
groups, representing the three successive stages of development:
prepubescence, pubescence, and post-pubescence.   "Puberty is usual-

ly the criterion of designation of one of the periods in almost every one of the multitude of classifications; it is probably the most interesting landmark in all life, for it is the point about which are grouped the most significant and peculiar phenomena of life. Acceleration and retardation in growth-rates, asymmetries and anomalies in structure, the disappearance of old, and the budding of new faculties and functions, together with the greatest and most fundamental of all, the change from asexual to a sexual life, all make puberty worthy of an extended and exact study." (17:142). Puberty is, for Crampton, not a stage, or period of time, but a division-line between two periods, having then, no more duration than the division between one year and the next. Adolescence is for him, the period from puberty to maturity. Pubescence(17:142) is a process which covers a period of time, the completion of which is often vaguely understood to be puberty. The term pubescence should be used to mean the process of becoming covered with hair, and unless qualified, should have reference to pubic pubescence only. The period of prepubescence, according to this contention of Crampton, should be regarded as beginning at birth and ending at the beginning of pubescence. All persons who have completed their pubescence are post-pubescent. The transition from the pre-pubescent stage is gradual. It is begun by an evident and rapid growth of the fine hair apparently already present: This is readily distinguishable, and this characteristic marks the first part of the period of pubescence. The second period of pubescence begins with the pigmentation of this exaggerated growth, and pubescence ends with the appearance of the kink or twist which is definitely char-

acteristic. It is on the basis of these stages that Crampton pro-
poses to classify pupils.

Chapter V.

Interrelation of the Various Ages.

A. School Age and Chronological Age.

According to one authority[1] the success of a free system of public education is tested partly by the number of years of schooling or the amount of work done by the pupils. If the school were properly organized, nearly all the pupils would proceed regularly from grade to grade, since they would be grouped in classes according to their ability and would be given such instruction as they could master in the time allotted to a given grade.

1. Elimination.

From studies which have been made in retardation and elimination, we readily see that our schools have not, by any means, reached this desired degree of perfection. By the time the fourth year of the elementary school is reached, elimination has become a considerable factor.[2] From this time on, elimination is present in large proportions and with remarkable regularity, until in the eighth grade we find only 40% of those who entered the first grade. Generally, schools retain most children who enter until they are eleven or twelve years old; there is a notable dropping out at eleven years; about one-half of the pupils have dropped out by the time they are fourteen years of age, and approximately five-sixths by the time they are sixteen years old. The approximate per cent. of school children reaching the

1. Strayer. (45, vol. V: 169)
2. Strayer.

various grades is as follows:

Grade	Per Cent.
IV	90
V	80
VI	70
VII	55
VIII	40
High School	
I	35
II	25
III	17
IV	14

These figures are medians reported by Strayer for the 319 school systems studied by him. Variations of these medians were many and often large.

About 25% of the children of the white population of our country who enter school stay only long enough to learn to read and write such simple English as they commonly use and to perform the fundamental operations with integers to a moderate degree of exactness. Only about one-third of the white children entering city schools graduate from elementary schools of seven grades or more, and fewer than one-tenth finish a high-school course. The elimination between the seventh and eighth grades and between the first and second-year in the high school is as great as that between the eighth grade and the first year of the high school[1]. The amount of elimination in schools of American

1. Thorndike (48:10)

cities (of 25,000 and more population) is shown in the following table, for about the year 1900 (Thorndike). The figures will be seen to be closely similar to those already quoted from Strayer.

Per cent. of pupils retained.	Grade to which retained.
	Elementary
90	IV
81	V
68	VI
54	VII
40	VIII
	High School
27	I
17	II
12	III
8	IV

Only one-fourth of the pupils who enter the elementary school ever enter the high school.

A table is presented by Thorndike(48:17) to show the per cent. of those entering the first grade that are eliminated at various later grades.

From the fourth to the fifth grade	9%
From the fifth to the sixth grade	13%
From the sixth to the seventh grade	14%
From the seventh to the last grammar grade	14%
From the last grammar grade to the first-year high school	13%
From the first-year high school to the second-year high-school	10%

From the second-year high-school to the third-year

high-school   5%

From the third-year high-school to the fourth-year

high-school   4%

This result can be shown perhaps in a more significant

manner by stating the per cent. of those in a given grade not

continuing to the next grade (48:17):

In the fourth grade not continuing to the fifth grade   10%

In the fifth grade not continuing to the sixth grade   16%

In the sixth grade not continuing to the seventh grade   20.6%

In the seventh grade not continuing to the last grammar

grade   26 %

In the last grammar grade not continuing to the first

high-school grade   32.5%

In the first high-school grade not continuing to the

second high-school grade   37 %

In the second high-school grade not continuing to the

third high-school grade   29.4%

In the third high-school grade not continuing to the

fourth high-school grade   33.3%

The elimination, then, is greatest from the first to the

second high-school years. Thorndike construes these figures as

evidence that a large share of the fault lies with the kind of

education given in the high school.(48:21). Whether this is true

is at least a matter of debate. One investigator[1] contends in

1. C.E.Holley, The Relationship Between Persistence in School and
   Home Conditions. Fifteenth Year Book, Part II. Nat. Soc. for the
   Study of Education.1916.

a recent work that elimination is due not to internal conditions but to factors outside the school's control. He concludes (Holley,109ff.) that:

1. The number of years of schooling of children depends largely upon the economic, educational, and social advantages in their homes.

2. Environment causes more dropping out of school than does lack of ability.

3. Internal factors in school tending toward elimination are almost insignificant when compared to social factors outside the school.

4. Early elimination from school is often due to parents' lack of appreciation of value of schooling.

5. Family tradition of schooling often tends to keep children in school.

6. Low economic status tends toward early elimination.

7. Large immigration frequently causes deterioration of s‡ school attendance.

Closely connected with the question of elimination is that of slow and rapid school progress.

2. <u>Retardation and Acceleration.</u>

By far the majority of pupils (70% according to some authorities) rated as statistically over-age are pupils who have really made slow progress; that is, have actually repeated one or more of the grades through which they have passed. One authority[1]shows that if inquiry is restricted to pupils who have

1. Blan(7:103).

not changed schools during their elementary course, the per-
centage of pupils in a given grade who repeat that grade is
4.4% in the eighth grade; 9.5% in the seventh grade; 7% in the
sixth grade; 2.4% in the second grade; and 3.5% in the first
grade. Thus, it appears that the seventh grade is the chief ob-
stacle in the progress of the pupils who persist in school. A
condition similar to that in schools making annual promotions,
also exists in systems in which promotions are made semi-annual-
ly. It has been cited[1] that of pupils who have reached the
eighth grade without changing schools, 45% as a median have
never failed to be promoted; 29% have repeated once; 20% twice;
4% three times; and 1% four times. Strayer (45:170) shows from
Blan's results that "Of those now in the eighth grade, a larger
percentage repeated in the fifth grade than in the fourth, a
larger percentage in the sixth grade than in the fifth grade,
a larger percentage in the seventh grade than in the sixth grade,
while in the eighth grade there were fewer repetitions than in
the seventh grade." The smaller number of repetitions in the
eighth grade may be due to the tendency to graduate even pupils
of poor attainments once they have reached this last grade in
the elementary school. Whatever may be the causes of retardation
and repetition, we find there are very few children who make
more than normal progress, partly because most teachers con-
sider normal progress as entirely satisfactory and partly be-
cause of the inflexibility of our promotion schemes.

In the investigation of Keyes[2] results were obtained con-

1. Blan(7:101)
2. Keyes (31:3-5)

cerning school progress somewhat at variance with those of oth-
er investigators. It should be pointed out that special con-
ditions were operating in the school systems studied. Thus, no
teacher had more than forty-two pupils; there was an ample sup-
ply of teachers and rooms; the pupil's ability to proceed was
carefully tested and principals were free to promote proven pu-
pils and no others.

The following conclusions may be quoted from Keyes'(31:14):

(a) "The number of accelerations is larger than the
number of arrests.

(b) "More boys than girls are found in the ranks of
accelerates.

(c)"Late entering into the first grade does not con-
tribute to acceleration/of progress. The average
accelerate enters school first under six years
of age.

(d)"The average accelerate has no difficulty in gain-
ing more than one full year in the first seven
years of progress through the gradesof the pub-
lic school.

(e)"Such possible accelerates are present in our
schools in large numbers, constituting from one-
fourth to one-third of our whole body of pupils
above the third grade."

Further, Keyes found(31:60-67)in these particular school
systems 24.9% of all the pupils enrolled in grades one to nine
were repeaters at some time in their school course, and that

29.6% of all pupils enrolled between grades one and nine were accelerates at some place in the course. The provision for special care of the less gifted or less fortunate, of the enforced absentees after their return, of those backward or mentally slow, undoubtedly kept the number of arrests nearer the possible minimum than is done in ordinary school systems. It is probable, thinks Keyes, that ordinarily between one-fourth and one-third of all pupils enrolled become arrests at some time in their school course. Arrest is likely to follow too early or too late entrance to school. Fifty per cent. of all children who enter grade one before the age of five years meet arrest at some place in the course, also 46% of those entering between seven and seven and a half years, and 49% of all entrants over seven and a half years become repeaters. Between the ages of five and fifteen, where nearly all the pupils are found, the years of special liability to arrest, according to Keyes' figures, are the ninth, tenth, eleventh, and twelfth. So,too, grades three, four, and five are particularly productive of arrest, just as they are particularly productive of acceleration. Of the whole number of repeaters, 21% do better after repeating, than before; 39% show no change; and 40% actually do worse. These results of Keyes are of particular interest because of their divergence from the usually quoted figures for retardation and more especially for acceleration. They serve to show, in the writer's judgment, that the relation between chronological age and school age is considerably affected by the organization and administration of the school system. Evidently, I mean, the number of

accelerated pupils will be much larger than commonly supposed
if there are adequate devices in the system for caring for the
abler children.

In addition to the causes or aids to acceleration mention-
ed above,as reported by Blan and others, many writers see, in
physical maturity, a very marked factor tending toward progress
of children, particularly in the upper elementary and lower
high school grades. This point will be discussed at length in
a later division of this chapter.

3. <u>School Standing and Age.</u>

It is shown that in cities having 25,000 **population** or
more, the median per cent. of boys of normal age is fifty-six;
of girls, sixty. In cities of less than 25,000 population the
median per cent. of boys of normal age is fifty-four; of girls,
fifty-eight. This means that in half of the cities having more
than 25,000 population, 56% or more of the boys are of normal
age, and that in half of the cities 56% or less of the boys are
ofnormal age. The median in each of the cases falls within a
group and is given as the per cent. for the whole group. Hence
the statement that half of the cities have 56% or more normal
and half the cities have 56% or less normal age.

The following table shows the median per cent. of the whole
number of boys and girls who are of normal age, over-age, or
under-age:[1]

1. (44:102).

	Cities over 25,000		:	Cities under 25,000	
	Boys	Girls	:	Boys	Girls
Normal	56	60		54	58
One year over-age	20	18		20	18
Two years over-age	10	9		11	8
Three years over-age	5	3		4	3
Four years over-age	2	1		2	1
Total over-age	38	32		38	36
Total under-age	4	4		4	5

Only 4% of the boys and 4% of the girls are under-age one year or more in 133 cities of a population of over 25,000; and only 4% of the boys and 5% of the girls are under-age one year or more in 186 cities under 25,000 population. In all years studied the girls show a slightly smaller per cent. of over-age pupils than boys.

It is maintained[1] that pupils of normal school-age or under have a better school standing, both as to grades and marks than those over-age, for the grade in which they are. However, it was found that there are waves or nodes in the marks from year to year for each individual, the most prominent drop coming at the entrance to the high school and in the fourth and fifth grades.

The comparison of school status and chronological age with school status and mental age is summarized in the following table compiled from results of an investigation on 483 children.

1. Baldwin(2:79)

(<u>Dougherty</u>)

	Per cent. retarded:	Per cent. at age	Per cent. accelerated.
Chronological Age	49.3	45.1	5.6
Mental Age	21.1	48.7	30.2

In other words the Binet tests show that more are in the normal grade, less than half as many retarded, and nearly six times as many advanced as when measured by the chronological standard.

The opinion is voiced by Strayer[1] that some readjustment is needed so that a larger per cent. of pupils might be in the ranks of normal or accelerated pupils. He says that "if the children who enter school under the age which is defined as normal were subtracted from the total under-age group, it would be evident at once that our schools do very little to encourage by rapid promotion the child of unusual ability. In spite of this condition comparatively little has been done for children belonging to special mental classes, especially for the apt pupil. We can find, however, many children from eight to fifteen years of age in the same grade. Under such conditions a teacher can not do the most efficient grade of work.

B. School Age and Mental Age

1. <u>Results of Binet-Simon Tests.</u>

Perhaps the best method of determining the relative school and mental ages of children is by a series of tests arranged

1. Strayer(44:103)

by Binet and Simon.For each year of age a list of questions is
offered, and these (or their equivalent, as previously discuss-
ed) should be correctly answered by the normal child of the
age in question. Though various investigators have found dis-
crepancies in results obtained by the use of these tests, (large-
ly, probably because of differing conditions of testing), in the
main they are considered valuable for locating the general men-
tal status of pupils up to 10 or 12 years of age.

A comparison has been made of the results of Dr. Goddard[1]
and Miss Dougherty[2] each of whom has used the Binet tests, ex-
tensively. Their results do not agree, as can be seen from the
table that follows.

Showing Position in School Related to Binet Standard:

(Dougherty)[3]

	Dougherty's figures		Goddard's figures	
	No.	%	No.	%
1. No. in grades ahead of what their mental ability measured by the Binet scale warrants (omitting grades 7and 8)	64	16.0	121	9.4
2. In right grade according to the Binet Standard (omitting grades 7 and 8)	147	36.9	558	43.2
3. In grades below what mental ability warrants (omitting grades 7 and 8)	101	25.3	558	43.2

On a basis of mental age Goddard found 43.2% in normal grade,

against Miss Dougherty's 36.9%; and 43.2% retarded, against

1. Ped. Sem. Vol. 18, No. 2.
2. (338:ff)
3. Dougherty (21:347)

against Miss Dougherty's 25.3%; and 9.4% accelerated, against
her 16%.

2. Range of Mental Ability.

(a) As shown by mental tests.

One investigator,[1] after testing 784 elementary school
pupils of St. Cloud, Minnesota, remarks: "The child re-
garded as exceptional by the school system, will be proved
exceptional by the tests, much more frequently than will
the child indicated as exceptional by the tests be found
to be exceptional in school work." It should be remember-
ed that Miss Lawrence used only the definition tests as
found in the Binet scale.

Children falling two or three years below the"at-age"
stage should merely be regarded as backward pupils, and
there exists much opportunity of making useful citizens
of them. They are backward, yet they may catch up with
the group, or at least learn the things usually taught
in the elementary grades and may go through school learn-
ing enough so that they may become useful and respectable
citizens, though perhaps always a little slow. Goddard
recommends that this backward group should not be asked
to do the regular work in the regular time, but should be
put into special classes of ten or twelve under special
teachers.

He declares[1] however, that those who are four or more

1. Miss Lawrence (35:215)
2. Goddard (26:872)

years behind the average can never live a normal life in any modern community and should be segregated for the sake of themselves and future society. "Their brain has never developed and never will." He suggests that they be set off in large colonies and made as happy and comfortable as possible, and that they should never be permitted to reproduce. He points out that this class is increasing at a fast rate and fears that there is danger of the race being swamped by degeneracy, since 65% of them have inherited their mental inferiority.

As a general result of three important investigations[1] Stern concludes that about one-half of the children are at their chronological age level; about one-fifth to one-fourth are a year retarded and the like number a year advanced; only a small percentage (at the most 11 per cent.) show more than one year of retardation and a still smaller number (at most 5.5 per cent.) is mentally advanced by more than one year[2]

Chambers, in a study[3] which he made on twenty-two seventh-grade and twenty-two eighth-grade children (thirteen in each group being girls) found rather striking conditions. These children were examined with respect to age, height, weight, strength of grip, quickness of perception, ability to add, ability to spell, rapidity of association, auditory memory, and visual memory. On the basis of results found,

1. Binet, Bobertag, and Goddard.
2. Baldwin (510:44)
3. Chambers (12a:61-75)

he came to the conclusions which are quoted here: (a)
"There exist the most surprising extremes of ability
among children comprising the same school grade, in every
physical and mental trait examined in this study; (b) In
not a single trait are the abilities of the entire group
distributed as in the normal frequency curve. There is no
well-defined center of gravity in any case; (c) The pecul-
iar form of the surfaces of frequency of the several tests
suggests the operation of some eliminating agency or agen-
cies which make this group of pupils a selected group; (d)
Neither grade nor sex seems to be responsible for the di-
vision of the groups studied into smaller groups of more
nearly equal abilities. The operative factors are probably
indeterminate for so small a group; (e) In all traits ex-
amined, except those of age, height, weight, and strength
of grip (in all of which nature's handicap of a year in
favor of the eighth grade is still effective) the ranges
of ability in the two grades are practically identical.
There is no line of demarcation; (f) The principles on
which the grading of our schools is carried out seemed
to be unrelated to all the traits, physical and mental,
here studied."

(b) As shown by school performance.

Similarly striking ranges of ability within the in-
dividual grades and a similar overlapping of grades were
found by another investigator[1] In handwriting 85% in the

1. Starch (43b:106-114)

fifth grade fell below the best in the fourth grade; 74% in the fourth grade reached or surpassed the poorest in the fifth grade. In another study[1] the same investigator found that in speed and comprehension of reading 31.8% of the pupils in any grade reached or exceeded the median of the next grade above; 20.1% reached or exceeded the median of the second grade above; 13.2% reached or exceeded the median of the third grade above; and 3.3% reached or exceeded the median of the fourth grade above. "In other words, approximately one-third of the pupils of any given grade could do the reading work of the next grade above as well as the average of that grade; one-fifth could do the work of the second grade above it as well as the average of that grade; and one-eighth could do the work of the third grade above it as well as the average of that grade."

The least variation Chambers, in his tests already referred to, found in any pupil was five different ranks in ten different traits. The poorest eighth-grade records in addition and spelling were surpassed by a third-grade child selected at random.

C. Mental Age and Chronological Age.
(Binet Results)

Goddard tested 1547 children in grades one to six at Vineland, New Jersey. In this investigation he found 554 children who tested

1. Starch (43a:1-24)

exactly at age. Three hundred twenty-nine tested one year above
the average, and 312 tested one year below the average. Forty-nine
were two years above the average; 14 were three years above; while
156 were two years below; 79 were three years below; 37 four years
below; 8 five years below; 6 were six years below; and 1 was seven
years below the average for their age. He thinks that "for prac-
tical purposes it will be entirely satisfactory to consider those
a year above and those a year below as forming a group with those
who are just 'at age' and consider all of these satisfactory pu-
pils. These constitute 78% of the total. Those more above than one
year advanced he would regard as especially well endowed. Those two
or three years behind are merely to be regarded as backward chil-
dren.

As a result of his investigation at Vineland, New Jersey[1] (in
which he tested 1547 children) Goddard concluded that the method
of testing children by the Binet scale is one of "marvellous ac-
curacy" and great practical value. The following shows some of the
results of this investigation:

	Number	Per cent.
At age	554	35.8
One year above-age	329	21.2
Two years above-age	49	3.1
Three years above-age	14	.9
Four years above-age	2	.1
One year below-age	312	20.8
Two years below-age	156	10.0

1. Goddard (26:871)

	Number	Per cent.
Three years below-age	79	5.1
Four years below-age	37	2.3
Five years below-age	8	.5
Six years below-age	6	.38
Seven years below-age	1	.06

D. Physiological Age and Chronological Age.

1. Pubescence and Age.

(a) Boys.

A statement is made[1], as a result of an observation
on 4,800 boys, that the boys not yet pubescent (as to
the pubis) are smaller and weaker than those who are.
This sign is second only in reliability for determining
the physiological development of children, to the direct
observation of the spermatazoon. It is easy to distinguish
between the complete absence of hair and an abundance of
the same and to designate the individual as prepubescent
or immature, or on the other hand, as post-pubescent, or
mature. To eliminate doubt as to where to place cases
which seemed to fall between these two extremes, an inter-
mediate class was established and called the pubescent,
or maturing class. This class contains all who have any-
thing more than an abundant lanugo or less than a very
well defined covering. A table is presented[2], based on
the investigation of these 4,800 boys, to show that each

1. Crampton (13:230)
2. Crampton (16:115)

chronological age-group contains sub-groups based upon
physiological age:

Relation Between Chronological and Physiological Age.

(Crampton)

Age in years	Physiological Age		
	Pre-pubescent	Pubescent	Post-pubescent
12.75	69%	25%	6%
13.25	55	26	18
13.75	41	28	31
14.25	26	28	46
14.75	16	24	60
15.25	9	10	70
15.75	5	10	85
16.25	2	4	93
16.75	1	4	95
17.25	0	2	98
17.75	0	0	100

Expected Number of Years Required for Pre-pubescents
to Reach Pubescence.   (Crampton)

Half-year age-groups	Average in years	Variability
12.74	1.37	.95
13.75	.97	.79
14.75	.78	.59
15.75	.55	.40

Number of Years Elapsed since Post-pubescent's
Pubescence.   (Crampton)

Half-year age-groups	Average in years	Variability
17.75	3.28	1.25
16.75	2.43	1.14
15.75	1.64	.98
14.75	1.13	.72
13.75	.70	.61

Relative Weights of Boys in the Various Stages of
Pubescence.   (Crampton)

Age in half-years	Weight in kilograms		
	Pre-pubescent	Pubescent	Post-pubescent
12.75	35.2	36.6	50.8
13.25	35.0	37.2	44.3
13.75	35.4	37.9	43.8
14.25	35.2	38.6	45.4
14.75	36.8	39.0	47.2
15.25	37.9	38.8	47.7
15.75	36.7	41.8	49.3
16.25	40.0	38.3	51.6
16.75	46.5	41.5	53.5

(b) Girls.

Menstruation in girls who are tall, healthy, and well-
nourished, may appear as early as the age of 11. If the
girl is tall but under weight, it may be delayed, and if
very short and markedly light, it may not appear before the
16th year.[1] Baldwin maintains that the prevalent idea that
menstruation should appear between the ages of 14 and 16

1. Baldwin (2:67)

is not tenable, "since the extremes in these cases repre-
sent normal healthy girls of different physiological de-
velopment." He cites Weisenberg as saying that girls who
have had their first menstruation before 13 years of age are
taller, as a rule, than those who have not reached this
stage in their physical development before 15 years of age.
In practically all races and climates the taller, heavier
girls with extensive lung capacity, mature physiologically
earlier than those below the average in these respects.
Baldwin found in his own investigation that there is a di-
rect correlation between the advent of first menstruation
and the stature of the individual; the taller girls mature
earlier than the ones below the median height. Another
writer[1] points out that there may be some very extreme
cases in sexual precocity. There have been found some cases,
probably pathological, in which the phenomena of menstrua-
tion appears as early as 1,2,or 3 years of age.

The following table(from Marro) of dates of the onset
of puberty in 261 girls shows the great variation in this
period:

Year	10	11	12	13	14	15	16	17	18	19	20	21
Number	1	6	16	34	16	54	40	29	12	4	2	2

2. Growth

That there is a close relation between bodily growth and
physiological age is the consensus of opinion of those who have

1. Terman (47:173)

made extensive investigation along these lines. This opinion is
supported by the following table:

| Age in half-years | Height in Centimeters | | (Crampton) |
	Pre-pubescent	Pubescent	Post-pubescent
12.75	144.0	147.5	150.5
13.25	144.2	148.7	153.9
13.75	145.7	150.4	155.9
14.25	146.6	150.6	157.9
14.75	147.3	151.7	158.9
15.25	149.8	151.5	160.7
15.75	149.8	153.1	162.6
16.25	151.0	152.4	164.6
16.75	153.0	151.4	165.4

From these figures it appears that the post-pubescents av-
erage as much as 11% taller than the prepubescents of the same
age. A dynamometer test showed similarly that post-pubescents
average 33% stronger than prepubescents of the same age.

The variabilities of all the physiological sub-groups have
been determined. The prepubescents are the least variable and
the post-pubescents most variable in weight, height, and strength.
There is a slight increase in the variability of weight and
strength in each physiological age as the age in years increases.
This is not the case with respect to height.

The variabilities as the age of 14.75 are given as typical:

	Prepubescent	Pubescent	Post-pubescent
Weight (Kilos)	5.18	5.83	8.09
Height (cm.)	5.96	6.37	7.51
Strength(Kilos)	4.96	5.66	8.46

An investigation[1] was made on 861 boys and 1,063 girls from
the University of Chicago elementary schools and high school,
the F.W.Parker School, of Chicago, and the Horace Mann School
of Teachers' College, Columbia University. Measurements were
taken semi-annually and in some cases annually, for periods of
from three to twelve years. In this investigation it was found
that boys are taller than girls from six to twelve; girls then
become taller and remain so until 14.5 years, when boys again
are taller.

From 6 to 13 years of age the yearly increment in height
varies from 1 to 8 cm. At the age of 12 the height increment is
decidedly larger,- as much as 12 cm. This period of rapid
growth continues up to 16 years of age. The increase from 6 to
about 7.5 years has no uniformity and seems to depend entirely
on the individual. From 8 to 11 the usual increase is from 7 to
9 cm. and in these years is found the greatest uniformity of
increase; that is, more boys increase the same number of centi-
meters than at any other time. In a few sporadic cases the in-
crement is reported to be as much as 10 cm.

According to Baldwin[2] "the widest range of individual dif-
ferences for boys and girls is during adolescence." Some of the
conclusions at which he arrives are worth quoting here: "The
trend of the height curve, aside from the period just previous
to the accelerated pubescent growth, tends toward convexity. The
increase in increments of growth and height just before the ac-

1. Baldwin (2:6ff)
2. Baldwin (2:69)

celeration is more marked with boys than with girls. If the
increase before adolescence is uniform, this uniformity tends
to persist throughout adolescence; if there is unusually rapid
growth for the individual from 7 to the beginning of adolescence,
there is a decrease in rate of growth during adolescence, and
there is a reversion of the common rhythmic order.

"Of boys and girls whose height curves are plotted for the
pre-adolescent ages, a few show a regular uniform rate of in-
crease at pubescence; more show an accelerated rate and fewer
show a decrease in gain.

"The cases of marked arrest in growth in height with this
group of children occur during the early adolescent period and
persist through the period.

"The children above median height between the chronological
ages of 6-18 grow in stature and physiological maturity in ad-
vance of those below the median height, and they may be physio-
logically from 1 to4 or even 5 years older than those below
the median height. Those above the median height have their
characteristic pubescent changes and acceleration earlier than
those below; there is a relative shifting of the accelerated period
according to the individual's height."

Height in Different Stages of Pubescence   (Foster)

No.	Stage of Pubertal Development	Average	Maximum	Minimum	Total
38	Prepubescents	146.7cm.	165.2cm.	130.9cm	35cm.
22	Pubescents, 1st grade	148.1	157.8	136.9	21
20	" 2nd "	152.2	162.5	140.2	22
56	" 3rd	153.6	167.0	140.8	27

40 Pubescents,	4th grade,	157.7cm.	175.4cm.	140.0cm.	35cm.
46 "	5th "	160.5	171.3	148.4	23
47 "	6th "	164.6	176.7	151.5	26
37 "	7th "	167.6	178.7	156.2	22

The skeleton of females has practically reached its full length by the age of 17, that of males by the age of 20. The period of acceleration of growth of girls is past by the fourteenth year, while then that period begins for boys, who now exceed the measurement of girls considerably.[1]

Before speaking of Burk's figures it is well to note that these were obtained on large groups of children, whereas those of Baldwin were obtained by successive measurement of a smaller group of children for periods from 3 to 12 years. These latter measurements were taken at semi-annual and in some cases at annual intervals.

Burk[2] confirms in general the conclusions already cited. He says that the average American boy is 44-45 inches tall between 6 and 7 years of age; at 12 years he is 55 inches tall, an increase of 10 or 11 inches for the 6 preceding years, or of about 20% of the height at the 6th year. He maintains that there is no material difference in the height of the sexes up to 10 or 12 years. Then the girls are taller for 2 or 3 years. The rate of growth for girls slackens at 14 or 15 and they usually reach their limit at 15, but may grow slowly for 2 or 3 years after this age. In boys the period of acceleration closes at 16. There is a wide individual variation at all

1.Boas (8:188)
2. Burk (11:255)

stages and also in the time of reaching the crises in the periods of growth, and these variations are about the same in both sexes.

The average stature of American children(in centimeters)[1]

Age	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Boys	105.90	111.58	116.83	122.04	126.91	131.78	136.20
Girls	104.88	110.08	116.08	121.21	126.14	131.27	136.62

Age	12.50	13.50	14.50	15.50	16.50	17.50	18.50
Boys	140.74	146.00	152.39	159.72	164.90	168.91	171.07
Girls	142.52	148.69	153.50	156.60	158.03	159.14	

Smedley[2] in his study of Chicago school children found similar results for stature.But he found that in weight the girl surpasses the boy about a year earlier than in stature and that she maintains her superiority in weight to a later period of time than she does her superiority in stature. He says that in sitting height, "the girls surpass the boys at the same age as in stature, but that they maintain their superiority in this measurement for one year longer than they do in stature, which indicates that the more rapid growth of the boys at this age is in the lower extremities rather than in the trunk."

The interuterine growth is very rapid. After birth there is a decreasing rate of growth until a plateau of almost no growth is reached at about 7 or 8. Then the rate of growth remains static until the pubertal age begins, when there may be

1. Boas' table according to Whipple (51:251)
2. Smedley (42:115)

an increase of one inch in a month and 20 pounds in weight and in the same time the muscular force may double. After this interval of one and one-half years there is a return to a slower rate and "the body and mind proceed with a stage of ripening which we call adolescence."[1]

There is little uniformity in the weight increment of children from 6 to 7.5 years; it varies from 2 to 15 kilo - grams. The increase begins to be a little more uniform at 7.5 years and a rough average can be taken, which is about 4 kilograms. This average stays almost the same up to 13. The greatest uniformity in the weight increment is from 9.5 to 10.5 and again from 14 to 15.5 years. The least uniformity of increase is from 12 to 13 years. The average increase in the ages from 11 to 17 is from 6 to 10 kilograms; the greatest increase (18 to 23 kilograms) is found between the ages of 12 to 16.5. The increase from 11 to 17 is so irregular that it is "almost impossible to strike an average."[2]

The average weight of American children is shown by the following table (in kilograms)[3]:

Age	6.5	7.5	8.5	9.5	10.5	11.5
Boys	20.50	22.41	24.72	27.03	29.66	32.07
Girls	19.69	21.64	23.81	26.03	28.53	31.52
Age	12.5	13.5	14.5	15.5	16.5	17.5
Boys	34.88	38.46	43.18	48.72	54.88	——
Girls	35.70	40.23	44.59	48.40	50.94	52.34

1. Crampton (14:ff)
2. Baldwin (2:6)
3. Boas' table according to Whipple (51:251)

Girls ~~35.70~~ ~~40.23~~ ~~44.59~~ ~~48.40~~ ~~50.94~~ 52.34

From this table we see that boys are slightly heavier
than girls of the same age-group up to and just before the on-
set of puberty; and that girls are heavier than boys between
the ages of 12.5 to 14.5. The year of accelerated growth is
the first year of post-pubescence. We observe that the various
authorities agree fairly well in regard to the height and
weight of school children.

Baldwin's measurements of individuals show that boys are
heavier than girls from 6 to 12 years of age, then girls be-
come heavier and remain so until 16, after which boys sur-
pass the girls. His weight curves were characterized by a
period of rapid acceleration during adolescence, except in
cases of marked arrest , which were usually accompanied by
marked arrest in growth in height. "The boys and girls below
the median height have their period of rapid pubescent ac-
celeration in weight later than those above, since the same
general principles of physiological age hold for weight as
for height as a rule."

Tables have been arranged[1] showing that the periods of
fluctuation of weight are more marked and more irregular in
girls than in boys. In boys the rising tendency in weight in-
crement reaches its height in the 8th,9th,or 10th years and
is then followed by a lessened increase in weight, reaching
its lowest point just before the pubertal increase. The pe-
riod of acceleration for boys begins from the 11th to the

1. Burk (11:260)

13th year and ends with the 16th year; the year of maximal increase is the 14th to 15th year. In the case of girls the increase of weight is a year or two earlier and usually ends in the 14th or 15th year; it is also of shorter duration than in boys.

3. Skeletal Development and Age.

Rotch has made a rather novel attempt at determining the physiological status of children, on the basis of the development of their skeletons. He says that "the epiphyseal index of development, although only one of the factors in the developmental problem, is more important and far-reaching than any other of the factors. The bones of the wrist can be relied upon to judge of the epiphyseal development without having to take Roentgen pictures of the other epiphyses."[1] He maintains that the appearance of the carpal bones and of the epiphyses of the radius and ulna serves as an index for the period of infancy and childhood up to the time when the child is about to enter the higher grades of study. After this time, he claims to "have recourse to another set of anatomic signs, which show the development up to the adult completion of ossification":- "the ossification and union of the epiphyses of the radius and ulna, metacarpal bones, and in succession those of the phalanges, which show the progressive development of the adolescent to the adult anatomically."

"The epiphyses which appear first are the last to unite and vice versa. The epiphyses of the radius unite at the

1. Rotch Am. Phys. Educ. Rev. Vol. 15:396ff.

eighteenth or nineteenth year, but appear very early in
childhood. The epiphyses of the terminal phalanges, which are
the last in the fingers to appear are the first to unite."
He thinks that the development of the epiphyses and carpal
bones correspond more to that of the brain than to the gener-
al physical condition.

The Roentgen-Ray method, according to Rotch, confirms
what other investigators in physiological conditions have
found, in that from results found *by it,* he concludes that there is
a precocity in the physiological development of girls over
that of boys.

Rotch has presented a series of pictures[1] representing
progressive stages of development from the first year of life
to the thirteenth or fourteenth. These, by a scheme of letter-
ing, he has classified into tables grouping the same stages
of development together. From these pictures he draws the
conclusions already presented. In one table (II) he shows
provisionally how each stage of development can be made to
correspond to certain grades in the elementary schools. An-
other table (III) shows the later development of boys than
of girls and the lack of correspondence of height, weight,
and chronological age. One series of pictures purports to
show how the Roentgen record can be used in deciding whether
a child should be held back or have his mental capacity stim-
ulated in order that it may be brought up to the epiphyseal
development.

1. Proc. of the Fourth Cong. of the Am. School Hyg. Assn. pp 190ff.

He is rather indefinite in his statements as to the exact value of some of his results, since he realizes that much still remains to be added by the educator through actual experimenting with the pupils in the various stages. It is precisely this indefiniteness upon which Crampton bases a part of his criticism of the Roentgen-Ray method. In particular does he (Crampton) emphasize the fact that there is no evidence to substantiate that there exists a relation between bone development in the wrist and physical or mental ability of any kind.

Rotch labelled the stages of development H,I,J,K,etc., but each stage appears to differ from the preceding only as Crampton says, in the fact that it is the "same as the previous only more so," that is, in stage J the bones are slightly more developed than in stage I and are more massed together. Crampton contends that this is merely a matter of opinion and not sufficient for scientific or practical purposes, and that the ossification does not proceed regularly throughout the body, there often being a difference between the right and left wrists.

4. Tooth Eruption and Age.

Bean[1] in a study of 2.221 Ann Arbor, Michigan, children 5 to 13 years of age, tried to find a norm for physiological age on the basis of tooth eruption. He says that the eruption of permanent teeth begins at about the age of 5 and is slightly earlier among girls. Boys and girls have almost exactly

1. Bean (3:596ff)
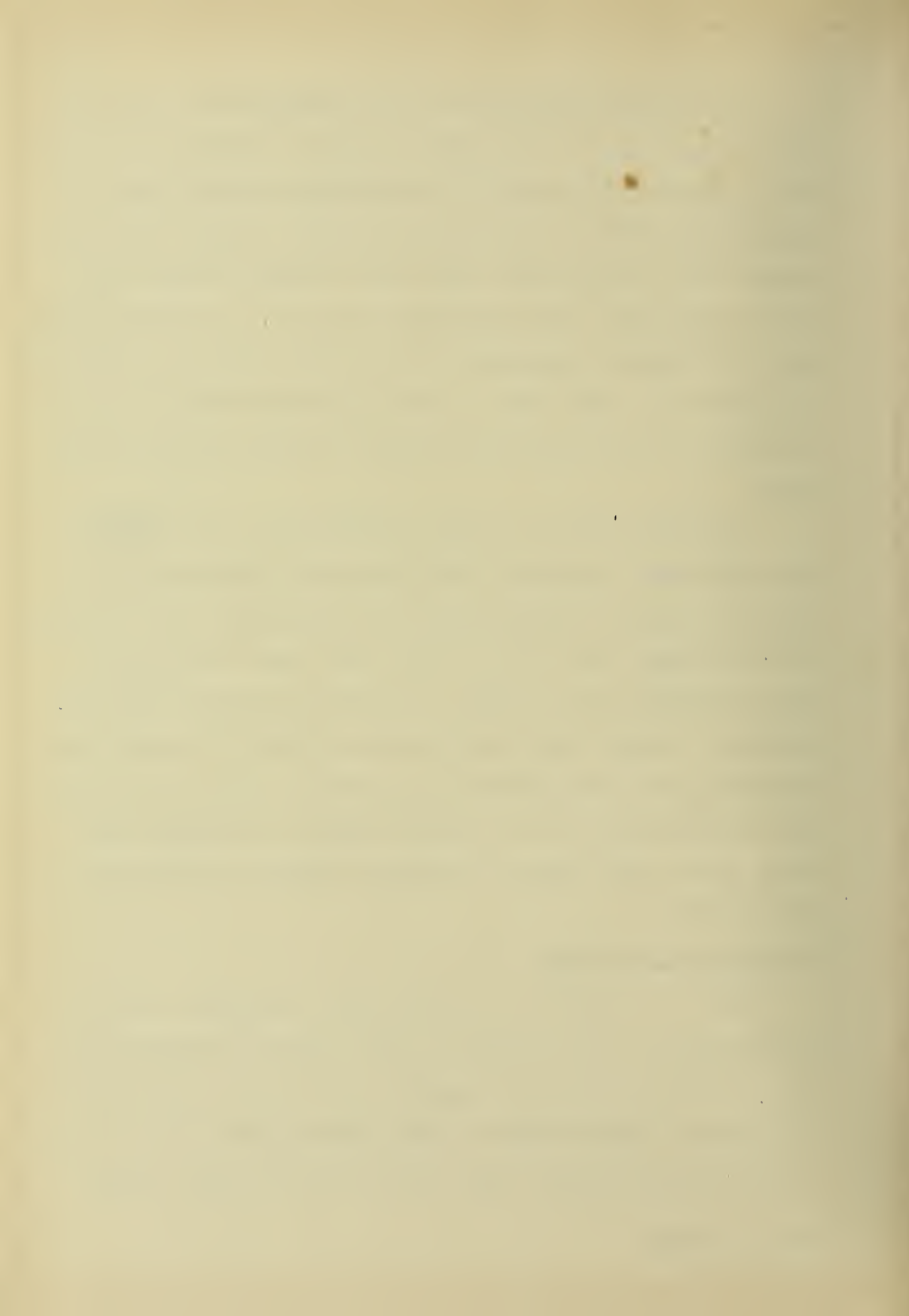
the same number of permanent teeth at the ages of 6,7,and 8,
after which the girls have the greater number until the age
of 15 is reached, when the number of teeth in the two sexes
is again about the same. At the age of 11 years American girls
have an average of 21.3 permanent teeth and the boys only 17.3.

There appears to be a relation of antagonism between tooth
eruption and general bodily growth. According to Bean, at
least,there are alternating periods of acceleration and re-
tardation in the development of the various structures of the
body. The period of acceleration in the development of one
structure may be concurrent with that of retardation of an-
other. Thus, (1) The First six months of age is a period of rapid
growth in body length, (2) Comparative rest in bodily growth,
accompanied by eruption of the temporary teeth, all of which
are through the gums by the third year, (3) Period of rest
in dental development, (4) Second period of rapid bodily
growth in length, (5) Beginning of eruption of permanent
teeth, (6) Accelerated bodily growth, (7) Second rapid erup-
tion of permanent teeth, (8) Third period of rapid bodily
growth, followed by puberty.

Ages at which Fifty Per Cent. of the Teeth are Erupted

(Bean)

	Girls		Boys	
	American	German	American	German
Lower first molars	5-6years	6-7years	6-7years	6-7years
Upper first molars	5-6 "	6-7 "	6-7 "	6-7 "
Lower median incisors	5-6 "	6-7 "	6-7 "	6-7 "

Upper median incisors	7-8years..	7-8years..	7-8years..	7-8years
Lower lateral incisors	7-8 "	7-8 "	7-9 "	7-8 "
Upper lateral incisors	8-9 "	7-9 "	8-10 "	8-9 "
Upper median premolars	9-11 "	9-11 "	10-11 "	10-12 "
Lower canines	9-11 "	10-11 "	11-12 "	11-12 "
Lower median premolars	9-11 "	10-11 "	10-12 "	11-12 "
Upper lateral premolars	10-11 "	10-11 "	10-12 "	10-12 "
Upper canines	10-11 "	10-12 "	11-12 "	11-12 "
Lower lateral premolars	10-11 "	11-12 "	11-12 "	10-13 "
Lower second molars	10-12 "	11-12 "	11-14 "	11-14 "
Upper second molars	12-13 "	12-13 "	12-14 "	11-14 "

The following explanation tends, perhaps, to avoid confusion in regard to the different terms used to designate the various teeth. Considering the right side of the upper jaw, the teeth are, in order from front to back; median incisor; lateral incisor; cuspid; canine, or eye tooth; 1st bicuspid, or median premolar; 2nd bicuspid, or lateral premolar; 1st molar; 2nd molar; and 3rd molar, or wisdom tooth. This arrangement is duplicated on the other side and in the lower jaw, giving 32 teeth in all.

The order of eruption of the different types of ˄teeth [permanent] for German and American children (that is, on a basis when approximately 50% of each type of tooth is erupted,) is ˄(1) first molars, (2) median incisors, (3) lateral incisors, (4) median premolars, (5) canines, (6) lateral premolars, (7) second molars, (8) third molars. All lower teeth erupt before the upper, except the premolars. Boas and Wissler place the end of

eruption of the permanent teeth as follows: first molars at
9 years; median incisors at 1. years; bicuspids 6-12 years;
canines 6-15 years; ~~the~~ lateral incisors at 15 years; and ~~the~~
second molars at 7-15 years.

Crampton also found a direct relation between tooth erup-
tion and height and weight; and since these are related to
pubescence, he thinks there is a relation between tooth ap-
pearance and pubescence.

E.   Physiological Age and School Age.

1. School Performance and Physical Maturity.

There is great divergency of opinion as to the causes of
discrepancy in school age of pupils of the same chronological
age. However, many investigators agree with the statement of
Keyes that conditions demand that the problem be approached
from a physiological standpoint.

Baldwin concludes that the taller, heavier, or physical-
ly accelerated boys and girls complete the elementary school
at an earlier age and with a higher average mark than the
short, light, or physiologically retarded boys and girls. The
boys who are in advance of their normal grades are above the
median height; those who have low school marks are slightly
below the median height. On a basis of his investigation he
recommends that the tall, healthy children of accelerated
physiological age be encouraged to proceed through school as
rapidly as possible within the limits of thoroughness and that
the small light children of retarded development be kept be-
low or in the normal grade, doing supplementary work, since

these short, light pupils are immature mentally, although in many cases precocious in brightness.

From an investigation on 33,500 children Porter (40:162ff.) concluded that mediocrity of mind is associated with mediocrity of physique and that there is a physical basis for precocity and dullness.

The table here reproduced shows the mean weights of boys and girls of each age from 6 to 16 for each grade.[1] (Porter)

Age at nearest birth-day	Mean weights	Wt. Of St.Louis boys distributed by grades Kinder- garten	I	II	III	IV	
6	43.74	43.58	43.29				lbs
7	47.73	45.55	48.48	52.00			"
8	52.58	47.80	51.79	54.43	57.00		"
9	57.75		55.87	57.64	59.66	61.75	"
10	62.48		60.19	61.14	64.00	64.91	"
11	68.47		63.50	65.45	68.12	69.24	"
12	73.61		70.00	69.50	72.17	73.86	"
13	79.85			74.25	75.95	78.43	"
14	88.08				81.00	84.00	"
15	100.20					89.00	"
16	114.17						

	V	VI	VII	VIII	H.S.	
11	71.29	73.94				"
12	74.69	77.29	76.50			"
13	80.90	82.17	83.50	82.00		"
14	87.83	87.20	93.63	97.50	86.50	"

1.Porter (40:165)

| 15 | | 95.33 | 99.17 | 105.50 | 105.17 | 105.08 | lbs |
| 16 | | | 114.50 | 104.00 | 114.00 | 123.00 | " |

Age at nearest birthday	Mean weights	Wt. of St.Louis girls distributed by grades					
		Kinder-garten	I	II	III	IV	"
6	41.84	41.65	45.08				"
7	45.84	43.87	46.76	49.88			"
8	50.35	46.50	49.60	52.10	53.17		"
9	55.17		52.57	55.44	57.18	60.00	"
10	60.46		57.00	59.59	61.15	61.64	"
11	65.64		66.34	62.95	65.50	66.77	"
12	73.23		71.75	69.80	71.50	72.74	"
13	83.73			79.50	76.50	81.93	"
14	93.94				90.50	87.17	"
15	103.20					98.50	"
16	115.69						"

	V	VI	VII	VIII	H.S.	
11	68.12					"
12	75.13	75.92	78.50	88.50		"
13	82.78	86.95	87.63	88.50		"
14	92.67	94.64	96.15	99.00	103.12	"
15	100.96	99.83	104.00	104.58	105.15	"
16		108.12	107.38	110.29	113.57	"
17				111.00	116.00	"

The mean weight of pupils in the higher grades is greater than that of all pupils at that age and exceeds still more the mean weight of pupils in the lower grades; also graphs of the tables show that precocious children are heavier and dull

children lighter than the mean child of the same age. A physic-
al basis of precocity and dullness is thus established, in
Porter's opinion, and is this difference in weight between dull
and precocious boys, which is declared to increase as they
grow older. (40:168) Smedley's investigation of 6,259 Chicago
children (42:76) confirms the conclusions given above. Accord-
ing to him, pupils of a given age in the higher grades are de-
cidedly superior in stature, weight, strength, endurance, and
vital capacity to children of the same age in the lower grades.

The following table shows the basis of Porter's conclu-
sions:[1]

Mean Weight of Boys of Twelve Years.	Pounds. (Porter)
In all grades	73.61
In first grade	70.
In second grade	69.5
In third grade	72.17
In fourth grade	73.86
In fifth grade	74.69
In sixth grade	77.29
In seventh grade	76.5
Mean Weight of Girls of Thirteen Years	Pounds (Porter)
In all grades	83.73
In second grade	79.5
In third grade	76.5
In fourth grade	81.92
In fifth grade	82.78
In sixth grade	86.95

1. (53:8) according to Zirkle.

In seventh grade   87.63

In eighth grade   88.5

Boas[1] however, criticizes these conclusions on the grounds
that the percentile method cannot be used, since there are three
factors which condition the rate of growth; hereditary influence,
preceding life history, and the average conditions during the
period under consideration. These conditions are not in such
relation as to stand in a percentile grade. He concludes from
an investigation which he himself carried on in Toronto that
just the reverse is true. In this investigation the teacher's
estimate of the pupil's intelligence was used, rather than his
school grade. It was found from the data compiled[2] that the
children pronounced bright by the teacher were less favorably
developed physically than those called dull. "Precocity bears
an inverse ratio to bodily development."[3]

In another investigation[4] (on children between the ages of
10.5-17 years) no physical examination was made, but the chil-
dren were classified on the basis of physical appearance. This
classification was made by the principal and a discriminating
woman teacher through observation of height and general physi-
cal appearance of the pupils. On the basis of this arrangement[5]
it appears that in pupils of corresponding development, girls
of each physiological age make slightly better showings in their
marks than do the boys; better work is done by the prepubescents

1. Boas (9:229)
2. (27:37)
3. West (50:108)
4. King (33:222ff.)
5. King (33:224)

of both sexes than by pubescents, and pubescents are superior
to post-pubescents. But when chronological age is taken into
consideration, it is seen that physiological development is
conducive to good school ability and that the chronologically
younger of each physiological age do better work than the chron-
ologically older groups[1]. The maturing pubescent age[2] in both
sexes is favorable to school progress, for at every age where
there is a significant number of cases, [pubescent] pupils are
in the upper classes in decidedly greater numbers than in the
lower classes. In one respect previous studies are confirmed
by these results, i.e., they indicate that over-age pupils in
the three physiological stages are inferior to those of normal
development.

Sex	Age	Degree of Maturity	Per cent. Good Grades	(King)
Girls	12-13years	immature	56	
"	12.5-13"	maturing or mature	69	
"	13-13.5"	immature	60	
"	13-13.5 "	maturing or mature	80	
Boys	14-14.5 "	immature	53	
"	14-14.5 "	maturing or mature	72	

While the number of cases in King's study is too small
to furnish conclusive evidence, the results indicate that the
scholarship of children of advanced physical development is
superior to that of those less fully developed. From this
study it appears also that maturity is favorable to progress

1. King (33:227)
2. King (33:228)

through the grades. Of 43 maturing boys between the ages of 13 and 14.5, over 79% were in the upper three classes, 7a-8a, as against 21% in the first three classes, 6b-7b; and of 51 maturing girls between 12 and 14.5 years old, over 85% were found in the three advanced classes as against 16% in the three lower classes. This indicates that maturing or mature pupils are superior to immature pupils between the ages of 12 and 14.5, and that inferior work seems to be associated with late maturity. Of the 14-year-old boys who are in the first half-year of the high school, only 57% are mature, while of boys of the same chronological age, but in the fourth or fifth half-years' work, 83% are mature. This indicates that, age for age, the mature have the advantage over the immature in their rate of school advancement.

A preliminary investigation made by Crampton (13:233) on New York City grade children is directly opposed to the findings just reported. This New York investigation revealed that in the fifth, sixth, and seventh years in the elementary schools the poor pupils are, on an average, 37%, 40% and 46%, respectively, more advanced in maturity than the good pupils. This is quite contrary to conditions found by the same writer in the high school. He recommends that children who mature in the lower grammar grades be given such instruction in the elementary school as will prepare them directly to take their station in active life.

Regarding pubescence and school grades, it is evident[1] that, age for age, the higher the grade, the fewer prepubescents;

1. Crampton (16:118)

that the scholarship of pubescents is above that of prepubes-
cents; and that the more advanced a group is in pubescence, the
better its scholarship will be. This is expressed by a scale
of percentages[1] in which zero means all prepubescents and 100
all post-pubescents. The members of the age-group 14.75 are
distributed over different high-school terms as follows: first
term 57.1%; second term 62.7%; third term 69.6%; fourth and
fifth terms 83.3%. This condition was found to be typical of
all age-groups studied. Greater height, weight, and strength,
all factors related to pubescence, are also found in the higher
grades.

Failures of Promotion to Next Term, 1st Year H.S Students.

(Crampton)

	Post-pubescents	Prepubescents
13 year age-group	18%	27%
14 year age-group	24%	34%
15 year age-group	29%	36%

Analagously, Bean (3:613) reports that at each age from
7 to 14, inclusive, the children who are below the modal grade
have 0.9 of a tooth less than those in the modal grade, and the
children who are above the modal grade have an average of 0.8
of a tooth more than those in the modal grade. The difference
is greatest at 10 and 11 years, when the second period of den-
tition is at its height, and the difference at these two ages
amounts to 1.5 and 1.8 teeth for those below the mode respect-
ively.

1. By Crampton.

2. <u>Desirability of Classification by Physiological Age.</u>

Some authorities,[1] in comments upon the very small per -
centage of acceleration in school, urge that maturity and abil-
ity should enter into a plan of grouping pupils.

It is recommended[2] that in all classes the mature and im-
mature should be separated into homogeneous groups. In the high
schools[3] according to Crampton, the post-pubescents do better
in their studies by from 30 to 50%; while in the elementary
schools the prepubescents lead by from 30 to 47%. One explana-
tion offered by him for this condition is that the subject
and methods of the elementary school are adapted to prepubes-
cents, those of the high school to post-pubescents. If we admit
these contentions, we can see the force of Crampton's plea that
admission to the high school ought to be based, in part at
least, on physiological age. As will be noted in a moment, there
is some doubt, however, as to the truth of Crampton's state-
ment about the superior ability of post-pubescents in the high
school. As evidence of the value of adapting educational meas-
ures to physiological age Crampton (18:6ff.) says that those
who deal with backward and exceptional children have very gen-
erally adopted the principle of classification on the basis of
physiological and psychological epochs; that some Y.M.C.A's
arrange athletic groups, and camping tours of boys on the basis
of pubescence and secure better results thereby. The same
thing is done by Dr. George Meylan of Columbia University on

1. Strayer and Blan.
2. Crampton (18:224)
3. Crampton (18:4)

his White Mountain trips and the boys are found to have a better time.

In Elementary School 64, Manhattan, Crampton divided the boys of each grade from 6b upward into physiological age-groups as determined by simple inspection. In this inspection he noted the voice, presence or absence of the second molars, height, weight, and the sub-cutaneous fat of the face and hands. (In the immature, sub-cutaneous fat is more evident and adheres more closely to the skin.) These pupils were grouped into three classes on the basis of maturity. As a result the teachers reported that school work was more satisfactory to the pupils and that the problems of discipline were practically removed. By such a classification it is claimed the school work can be adapted better to the needs, ability, and interest of the pupils in each group.

An experiment of particular interest in this connection was made at the New York High School of Commerce in 1902 when 295 of the Freshman boys were classified into eight sections on the basis of physiological age (degree of pubescence determined by inspection), and the subsequent school work of these boys was compared with that of 149 other boys in the same class arranged in sections indiscriminately, and also with the work of 318 boys in the same school in the preceding year, also arranged in sections indiscriminately. The results, as reported by Foster (22:85), indicate that the net effect of the classification by physiological age was to reduce the number of discharges in the class as a whole, but that the discharges were much more

frequent in the post-pubescent groups than in the least mature groups. It is difficult to reconcile this second result with the declarations made by Crampton elsewhere (18:4) and quoted above in this paper to the effect that post-pubescents do from 30 to 50% better in their work in high school.

Effect of Classification by Physiological Age on High-School Freshmen.　　　　　　　(Foster)

Group I (8 classes arranged according to physiological age)

Registered	Discharges by Ages						Failures		Promotions	
	14	15	16	17	Total	Per Cent	No.	Per Cent.	No.	Per Cent.
1. 39	0	0	4	3	7	18.00	14	36.00	18	46.00
2. 38	1	7	4	1	13	34.10	4	10.60	21	55.30
3. 38	2	3	0	0	5	13.10	11	28.95	22	57.99
4. 37	1	5	2	0	8	21.60	11	29.70	18	48.70
5. 41	2	4	3	1	10	24.40	5	12.20	26	63.40
6. 32	2	1	0	1	4	12.50	3	9.30	25	78.20
7. 34	5	2	0	0	7	20.60	2	5.80	25	73.60
8. 36	3	0	0	0	4	11.10	8	22.20	24	66.70
295	16	22	14	6	58	19.66	58	19.66	179	60.68

(Sections are numbered one to eight beginning with the most mature and ending with the least mature.)

Group II (4 classes not arranged according to physiological age)

Registered	Discharges by ages						Failures		Promotions	
	14	15	16	17	Total	Per Cent.	No.	Per Cent.	No.	Per Cent.
1. 45	6	7	2	1	17	37.8	11	24.4	17	37.8
2. 32	2	2	3	2	10	31.2	3	9.4	19	59.4

3.	26	2	2	2	0	6	23.0	5	19.2	15	57.8
4.	46	7	4	1	0	13	28.3	6	13.0	27	58.7

A further investigation of a previous class of 3.0 boys, classified rather indiscriminately, shows the following percentages of discharges, failures, and promotions:

Group III (not classified):

Registered 318; discharges 27%; failures 17%; promotions 56%.

For easy comparison we may group the results of the three investigations:

Group	Registered (No)	Discharges (per cent.)	Failures (per cent)	Promotions (per cent.)
I. 8 classes arranged according to physiological age	295	20	19	61
II. 4 classes not arranged according to physiological age	149	31	17	52
III. Previous class not arranged according to physiological age	318	27	17	56

We see thus that the marked difference is in the discharges. The eight divisions were arranged according to degree of development - the eighth class being composed almost entirely of prepubescents. It is shown that the smaller boys are the best students, rather than those farthest developed physically. The records of the smaller boys show fewer discharges, fewer failures and more promotions. The most obvious explanation for this superiority of the immature boys is that they are bright and capable boys where school progress has not been re-

tarded but rather accelerated, at least relatively in comparison with the older post-pubescent and pubescent boys. To this Foster adds the suggestion that the work of the older boys in high school is often handicapped by taking on outside work for earning money, by more extensive and active participation in athletics, social and other extra-classroom activities of the school or by their having interrupted their school career for a year or more after graduation from the elementary grades.

On the other hand, we understand Crampton to dispute the assertion that the younger (immature) boys do the best work in the high school. A quotation from him in a letter to Prof. Whipple will confirm this point and make clearer the matter at issue between Crampton and Foster.

"With reference to pages 23,24,and 25 American Physical Education Review, it will be clear that advance in puberty is correlated with advance in term and in positive fashion. This result was obtained from the records of 3,800 boys as against Foster's 295. Table sixteen shows the percentage of post-pubescent at [the age of] 14.25 in the first term is 57.1. This rises to 83.1 in the fourth and fifth terms. This is characteristic of the rest of the table......

"The use of the second method [is] based upon the number of hours of failure; it is clear that of these 3,800 boys each year after 13,14,15 more post pubescents "pass". I doubt if this can be overturned by an analysis of 295 cases particularly where the results show such a tremendous variation as noted in Foster's article, page85, "Percentage of Failures." Furthermore ....his results are based upon observation of segregated groups in which each group is composed of boys placed with school mates of their own physiological age in accordance with my recommendation. I have maintained that this means better scholarship of all groups. If Foster has shown that the pre-pubescents are better scholars than post-pubescents, it may be due to the fact that this classification has made them so, for it certainly does not appear to be true under ordinary school conditions. Furthermore, Foster's results are for the first term, which is more like the elementary school than the group I use;i.e. the first two terms. In the elementary school it is clear that the pre-pubescent is the better scholar.....Hence, we would expect them to be less worse in the first term in high school than in the second term.

"The improvement in scholarship resulting from the use of my plan of segregation is important from the school-man's point of view, but my most important result will come from the adaptation of various courses of study to the different needs of the segregated groups which adaptation will take place as soon as groups are segregated. This is far-reaching, and will, as already indicated by the latest New York report, have a great influence in modernizing our educational administration and method.

"The reprint from the proceedings of the International Congress on Hygiene and Demography will indicate the progress already made up to a year ago. Since then, I have introduced this method into over one hundred classes and the results are just the same as found in Grady's school. This year we are going ahead."

F. Physiological Age and Mental Age.

This relationship appears to have received relatively little careful investigation. The extensive studies of mental age conducted by means of Binet and other mental tests have related mental age, as we have seen, to school age and to chronological age rather than to physical age. Not only this, but in a certain sense it could be declared that the term 'mental age' here refers more to general intellectual ability than to mental maturity. In other words, it is possible for one child to be superior to another in mental age, meaning intellectual ability and attainments, and yet be at a younger stage of mental maturity.

Almost the only case in which a close correspondence appears to have been made out between physiological age and mental maturity is that of the parallelism, quite generally accepted, between the physical phenomena of puberty and certain characteristic and corresponding changes in the mental life of adolescents.[1]

1.It seems unnecessary to go into detail concerning this particular physical and mental ripening. The reader may consult Hall's well-known text, Youth and his larger two volume Adolescence. A summary of the physical and mental traits of adolescence prepared by G.M.Whipple is in ch.7 in Monroe's Prin. of Sec. Educ.

It is important to note in this connection that those who, like Crampton, urge the extensive use of physiological age in place of mental age as a basis of classification in school work, or for various purposes of investigation, really have in mind the mental more than the physiological traits of the pupils in question. In fact, it appears to the writer that no particular stress can be laid upon the use of physiological age as a basis of classification unless it can be shown that this reference to physiological age is a reliable means of securing a classification in terms of psycho - logical status. In other words, whenever we posess definite information concerning the mental maturity of the pupil we shall naturally use this information and shall feel no obligation or necessity to probe into his physiological age.

Just at present, with the single exception of the criteria afforded by the pubertal phenomena (menstruation and pubescence), there seem to be no methods of determining physical age that are in any way as convenient and as reliable as the various methods developed in the psychology of mental tests for arriving at the mental age of the pupil.

To revert to the point just made that those who favor classification by physiological age really have in mind the mental more than the physiological traits of the pupil we may cite the following from one of Crampton's articles (18:5,8,11)[1]:

"The sexual ripening determines an entirely new outlook upon life, the earning instinct looms large in the boy, and the home-making instinct in the girl.

1. Reprint from Transactions of the Fifteenth International Congress on Hygiene and Demography, 1912. (Crampton).

"The important fact that is constantly disregarded is the fact that the pubertal change leaves the child a wholly different being - different mentally, physically, morally, and ethically from the children in the stage just left behind.

"This disregard results in the endeavor to teach classes that are composed of children of both prepubertal and post-pubertal stages, the immature and the mature.

"Sitting alongside of each other, receiving the same teaching, subject to the same regulations and discipline, are children three or more years past puberty, and others three or more years lacking before the change will occur. The result is chaos. No one course of study can be fitted to their separate needs, and no one form of discipline can be enforced with each group with equal success.

"This condition obtains in the whole of the grammar department of the elementary school. It is particularly troublesome near the point of articulation of the two schools......

"I present the opinions as follows: Social consciousness is solidified; a feeling of solidarity in older groups becomes apparent, whereas in the mixed group the older boys found themselves separate and often isolated individuals.The tone and consciousness of the class was one in which the most successful scholars, who were mainly the immature, became predominant and the older boys were out of the social current. The separation of the mature group from the immature gave a class in which each exhibited to all the similar aspects of maturity, and allowed them to feel the presence of neighbors of their own kind with similar social and scholastic tendencies, abilities, and disabilities. As one teacher expressed it: 'In the mixed class the older fellows didn't get together, now they do.' This feeling of solidarity has resulted in making discipline easier for teachers who recognized it, and harder for teachers who did not. Practically all the teachers became aware of the change, as it developed, and adapted their methods of control to meet the occasion...,...

"The results substantiate the claims made for this method in my previous reports, and may be summarized as follows:
   1. Boys in a homogeneous class feel more at home, and form for themselves a coherent social consciousness.
   2. Consistent methods of management and discipline may be adapted to the whole class.
   3. Choice of subject matter may be made appropriate to all, instead of a fraction of the class.
   4. Teaching methods and manner of appeal may be chosen with the problem of but a homogeneous instead of a diverse group of students.

"The whole should render school management more simple and teaching more effective."
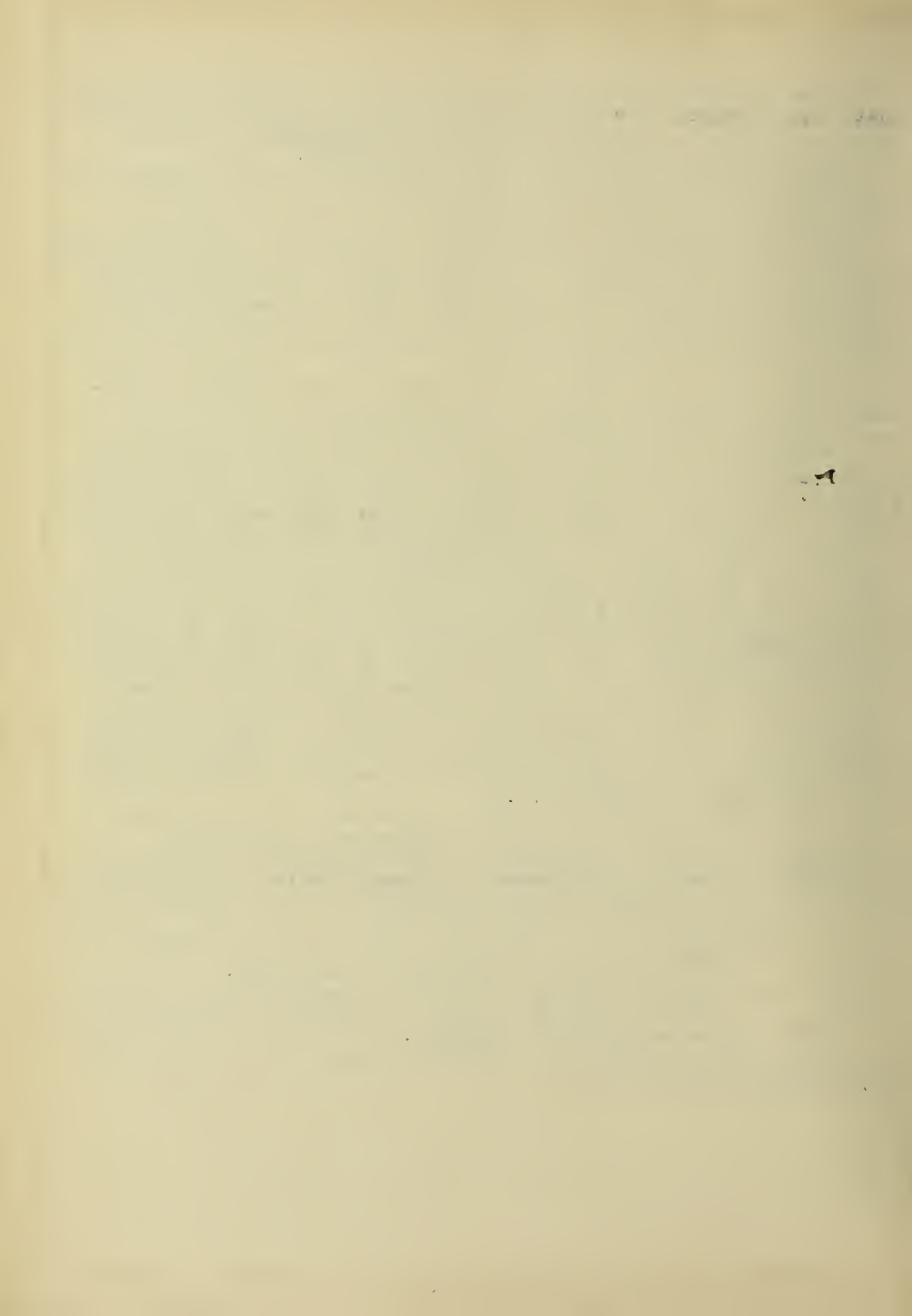
Chapter VI.

Bibliography.

1. Baldwin, B.Thos.   Individual Differences in the Correlation
                          of Physical Growth of Elementary and High
                          School Pupils. Jour. of Educ. Psychol.II:
                          1911, 150-152.

2.   "   " "   Growth and School Progress. U.S.Bureau of
                          Educ. Bulletin No. 10,1914.

3. Bean, Robt. Bennet.   The Eruption of the Teeth as a Physiolog-
                          ical Standard for Testing of Development.
                          Ped. Sem. XXI: 1914, 596-614.

4. Beik, Arthur K.   Physiological Age and School Entrance. Ped.
                          Sem.XX: 1913, 277-321.

5. Bell, J.C.   Recent Literature on the Binet Tests. Jour.
                          of Educ. Psychol.III: 1912, 101-110.

6. Beyer, H.G.   Relation Between Physical and Mental Work.
                          Amer. Phys. Educ.Rev.,V: 1900, 149-160.

7. Blan, Louis Benjamin. A Special Study of the Incidents of Retard-
                          ation. (Columbia Teachers' College.)

8. Boas. Franz.   Growth. Monroe, Cyclopedia of Educ.,III:
                          187-189.

9.   "   "   On Dr. Townsend Porter's Investigation of
                          the Growth of School Children of St.Louis.
                          Science, n.s.I: 1895, 225-230.

10.Bobertag, Otto.   Uber Intelligenzprufung (Nach der Methode
                          von Binet und Simon). Zeitschrift.fur
                          Angewandte Psychologie,V: No.2,1911,105-
                          203.

11.Burk, Frederic.   Growth of Children in Height and Weight.
                          Amer. Jour. of Psychol., IX: 253-326.

12.   "   "   The Influence of Sex upon Growth. Amer.
                          Phys. Educ. Rev., IV: 1899, 340-349.

12a. Chambers, W.G.   Individual Differences in Grammar Grade
                          Children. Jour. of Educ. Psychol.I: 1910,
                          61-75.

13.Crampton,C.Ward.   Anatomical or Physiological Age: Versus
                          Chronological Age. Ped. Sem.,XV:1908,230-
                          237.

14. Crampton, C.Ward.   The Differences Between Anatomic, Phys-
                         iological, Psychological, and Chrono-
                         logical Ages as Causes in Derailment.
                         Proc. Nat'l Assn. for the Study and
                         Education of Exceptional Children. Apr.
                         1910: 70-75.

15.   "   "   "   The Effect of the Doctrine of Physio-
                         logical Age upon School Administration.
                         Jour. of Educ. LXXV:1912, 462-463; 490-
                         491.

16.   "   "   "   The Influence of Physiological Age upon
                         Scholarship. Psychol. Clinic,I:1907,
                         115-120.

17.   "   "   "   Physiological Age - A Fundamental Prin-
                         ciple. Amer. Phys. Educ. Rev.,XIII:1908,
                         141-154; 214-227; 268-283;345-358.

18.   "   "   "   The Significance of Physiological Age
                         in Education. Transactions of the Fif-
                         teenth International Congress on Hygiene
                         and Demography,1912.

19. Debusk,B.W.   Height, Weight, Vital Capacity, and Re-
                         tardation. Ped. Sem. XX:1913, 89-92.

20. Decroly,O.   Intelligenzmessungen dei normalen und
                         abnormalen Kindern. 2 Kongr. exper.Psy-
                         chol. Wurzburg,1906,187-193.

21. Dougherty, Mary L.   Report on the Binet Simon Tests Given
                         to 483 Children in the Public Schools
                         of Kansas City, Kansas. Jour. of Educ.
                         Psychol.,IV:1913,338-352.

22. Foster, W.L.   Physiological Age as a Basis for the
                         Classification of Pupils Entering the
                         High School. Psychol. Clinic,IV:1910,
                         83-88.

23. Freeman, F.N.   Tests. Psychological Bulletin, IX:1912,
                         215-222.

24. Gilbert,J.A.   Researches on the Mental and Physical
                         Development of School Children. Studies
                         from Yale Psychological Laboratory,II:
                         40-100.

25.   "   "   "   Researches upon School Children and Col-
                         lege Students. U. of Ia. Studies in
                         Psychol.,I:p.897,1-39.

26. Goddard, H.A.   Two Thousand School Children Tested by the .Binet Measuring Scale for Intelligence. Proc. Nat'l. Educ. Assn. San Francisco,Cal. July 1911, 870-878.

26a.Gray,C.   Variations in the Grades of High School Pupils.

27. Hall, G.Stanley.   Adolescence.I , various chapters.

28. Hartwell, E.M.   Bowditch's Law of Growth and What It Teaches. Am.Assn.for the Advancement of Phys. Educ.1996,23-30.

29.Hastings,W.W.   Anthropometric Studies in Nebraska. Am. Phys. Educ.Rev.V:1900,53-66.

30.Hallingsworth,Mrs.L.S.   Functional Periodicity: An Experimental Study of the Mental and Motor Abilities of Women During Menstruation (Columbia U. Studies).

30a.Holmes,W.H.   School Organization and the Individual Child.

31. Keyes, Charles Henry.Progress Through the Grades in City Schools; A Study of Acceleration and Arrest. (Columcia U. Studies).

32. King, Irving.   The High School Age. Chs.II,III,IV.

33.   "   "   Physiological Age and School Standing. Psychol. Clinic,VII: 1914:222-229.

34. Kohs, Samuel C.   The Binet Simon Measuring Scale for Intelligence: An Annotated Bibliography. Jour. of Educ. Psychol.,V:215,279,335.

35. Lawrence, I.A.   Study of the Binet Definition Tests. Psychol. Clinic,V:1911, 207-216.

36. Macdonald, Arthur.   Experimental Study of Children. U.S.Bureau of Educ.Report of the Commissioner of Educ. 1897-1898,I: 989-1204; II: 1281-1390.

37. Mead, Cyrus D.   The Age of Walking and Talking in Relation to General Intelligence. Ped. Sem.,XX:1913 460-484.

38.   "   "   "   Height and Weight of Children in Relation to General Intelligence. Ped. Sem.,XXI: 1914,394-406.

39. Pearson,K.   Growth of St.Louis Children. Nature,LXI: 1894,144-146.

40.Porter, W.Townsend.   The Physical Basis of Precocity and Dull-
                           ness. Transactions of the Academy of
                           Science of St.Louis, VI:1892-1893, 161-
                           181.

41. Rotch,T.M.   Roentgen Ray Methods Applied to the Grad-
                           ing of Early Life. Am. Phys. Educ.Rev.XV:
                           1910, 396-420.

42.Smedley, F.W.   Report on Child Study in Chicago, 46th
                           Annual Report of the Board of Educ. of
                           the City of Chicago for the year ending
                           June 30, 1900.

43. Snedden,David.   Grading and Promotion. Monroe, Cyclopedia
                           of Educ.

43a. Starch,B.   The Measurement of Efficiency in Reading.
                           Jour. of Educ. Psychol., VI:1915, 1-24.

43b.   "   "   The Measurement of Efficiency in Writing.
                           Jour. of Educ.Psychol., VI:1915, 106-114.

44.Strayer, George D.   Age and Grade Census for Schools and
                           Colleges. U.S.Bureau of Educ. Bulletin
                           No.5, 1914.

45.   "   "   "   Retardation and Elimination. Monroe,Cy-
                           clopedia of Educ.

46. Terman, L.M.   The Binet Simon Scale for Measuring In-
                           telligence: Impressions Gained by its
                           Application on 400 non-selected Children.
                           Psychol. Clinic,V:1911, 199-206.

47.   "   " "   A Study in Precocity and Prematuration.
                           Am. Jour. of Psychol. XVI: 1905,145-183.

48. Thorndike, Edward L. The Elimination of Pupils from School.
                           U.S·Bureau of Educ. Bulletin No.4,1907.

49. Wallin, Wallace J.E. The Rationale of Promotion, and Elimina-
                           tion of Waste in the Elementary and Sec-
                           ondary Schools. Jour. of Educ. Psychol.,
                           I:1910, 445-456.

49a. "   "   " " Experimental Studies of Mental Defectives.
                           (Educ. Psychol. Monographs).

50. West, G.M.   Observations of the Relation of Physical
                           Development to Intellectual Ability made
                           on School Children of Toronto, Canada.
                           Science, n.s.IV:1896, 156-159.

51. Whipple, G.M.   The Psychology and Hygiene of Adolescence

Chapter VII in Monroe, Principles of Secondary Education.

51a. Whipple, G.M.   The Psychological Methods of Testing Intelligence. Translation from Stern,Wm. Die psychologischen methoden der Intelligenzprufung.

52.   "   " "   Manual of Mental and Physical Tests.1914 Edition.

53. Zirkle,H.W.   Interdependence of the Mental and Physical Univ. of Colo. Bulletin, 1902,I:3-23.